The page features three decorative purple circles of varying sizes, each composed of concentric circles with a gradient from dark purple to light purple. Two thin purple lines intersect at the top left, forming a large 'V' shape that frames the circles. The largest circle is at the top right, a medium one is in the center, and the smallest is at the bottom right.

Kindergarten Teachers' Knowledge of Incoming Students' Readiness in Mathematics

Thesis

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Submitted in Partial Completion of the Research
Master of Arts Degree

Shannon Lee Squires
6/30/2009

Acknowledgements

This entire process has been rewarding and challenging. Completing my first Master's degree in Mathematics Education with instructors Dr. Geneviève Boulet and Evan Robinson inspired me to continue with educational research on early elementary mathematics. I am grateful to Geneviève for agreeing to supervise this thesis project. Geneviève has gently eased me into the world of academic writing; her support and critique is always accurate and appreciated. Her friendship is invaluable. Merci.

I would also like to thank my committee member, Dr. Mary Jane Harkins, for accepting to participate in the successful completion of this study. She has been enthusiastic about the topic I've chosen, and her guiding comments and questions make me reflect on my own work in a progressive and meaningful way.

This graduate degree challenged me in ways that none of my other degrees have; these challenges have very little to do with academics, but balance. My first daughter was born days after my last class for my MEd ended, and my second was born eleven months after that. Geneviève Lee (named after my great grandmother, with an inspirational living namesake as well) and Aviendha Mallory obligated me to balance my home, work, and academic lives. I believe that being a mother makes me a more efficient person, and has obligated me to develop remarkable strategies for time management. My husband Eli encourages me to pursue my ambitious goals and grants me the flexibility to accomplish them.

I am grateful to my peers, Marianne, Marsha, Melissa, Marisa, Jennifer, Crystal and Todd, who have validated, piloted and critiqued the online survey which is the backbone of the study. All comments were intelligent, constructive, and certainly helped to make the instrument more user-friendly and accurate.

The challenges of creating an online instrument to collect data were generously undertaken by Paul Lindgreen, Interim Web Administrator for the Technology and Services Department at Mount Saint Vincent University. I am very appreciative of his helpfulness and efficiency in creating and updating the online survey. Dr. Eva Knoll shared her personal experience in conducting a survey for a PhD project. Her suggestions for coding and interpreting data in Excel made this process much more efficient.

Abstract

This study contributes to the specific area of mathematics readiness in Kindergarten. The purpose of surveying teachers was to determine how individual teachers currently assess their students' literacy readiness and mathematics readiness and whether there is, indeed, a gap in resources available to support mathematics readiness. Data on early elementary readiness was collected with an online survey. For statistical analysis purposes, information was collected on literacy and mathematics readiness; data was analysed with mathematics readiness as the focus. To secure a large sample, teachers in a variety of teaching positions completed the survey, and Kindergarten teachers (along with participants who indicated that they have previously taught Kindergarten) were isolated for analysis purposes. Results indicated that teachers, and particularly Kindergarten teachers, perceive prior knowledge as the most important indicator for school success; however, no Kindergarten teacher reported the use of any standardized mathematics assessment, and many reported that they do not use informal methods for collecting this information. Results also indicate that Kindergarten teachers have unique challenges in instruction and assessment methods; many Kindergarten teachers prefer working with students in centres or small groups for instruction, and assessment should follow this practice. Implications from the results of this study indicate that Kindergarten teachers would benefit from a creative and specifically tailored Kindergarten mathematics readiness assessment tool. This study provides important insight into the type of mathematics readiness assessment tool that would provide teachers with the necessary information to help them plan more effectively, improving and informing their instructional practices. Based on results from this study, such a mathematics readiness assessment tool should be task-based, versatile enough to be adapted to centres, and manageable for implementation at any point in the school year. Teachers require more support to assess mathematics readiness, and guidance to inform instructional planning. In addition to the specific research area of early elementary mathematics readiness, results from this study may also be of interest to researchers in the areas of mathematics curricula design and implementation, and the areas of Kindergarten school readiness, and early elementary literacy.

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Introduction

Kindergarten offers particular challenges to children and their teachers that differ from the other grades. Beyond the first year of school, children know relatively well what to expect from school. In contrast, Kindergarten-aged children (and to a great extent Kindergarten parents) often do not know what to expect from school, may have misconceptions, and may suffer from anxiety over beginning this new 13-year long formal learning experience. Likewise, with any grade past the first year of school, teachers know more or less what to expect from the children. There are curriculum outcomes that a teacher can expect children to have met in the previous year, along with report cards and other assessment and evaluation results documenting each child's individual development in various academic and social areas. Kindergarten, on the other hand, is brand-new. Children can be randomly assigned to classes with no true indication of how they may get along with other children, or how ready they are to achieve the outcomes set out in the Kindergarten curriculum. In small rural schools with only one class per grade level, all students are in the same class regardless of behavioural, academic or social needs. Kindergarten teachers help parents understand what formal school means for their child and how they, as parents, can contribute to their child's education. Parents' perceptions of their children's preparedness for school are sometimes often under- or over- anticipated, due to a natural protective parental bias that exists. In my opinion, Kindergarten teachers cannot therefore solely rely on parents' perceptions of their child's readiness for the academic and social requirements of school; nonetheless, parents are the adults who know their children best, and do have insight into their children's personality, behaviour patterns and readiness that Kindergarten teachers will not have.

While each Kindergarten group is as different as the individual students who comprise them, the outcomes teachers facilitate children to meet are the same year after year; no matter how many years a teacher teaches the same grade, it remains a demanding task. Kindergarten teachers have the

challenging task of melding students who have had very different prior experiences into a cohesive group that must, by the end of the year, be identified and achieve “grade level”. This is not to say that other grade level teachers do not experience similar difficulties in delivering programs to multi-levelled classes with children on Adaptations and Individual Program Plans; rather, in the case of Kindergarten teachers, they begin each year uninformed of the backgrounds their students. Indeed, since there are no cumulative student files to consult, the children and their families are enigmas for the first few months. Including parents in the process of gathering information about each child’s strengths and challenges can help Kindergarten teachers plan and adapt in general, but academic information is also needed, and parents may not have this specialized insight. Literacy assessments are readily available to Kindergarten teachers, but there are no assessments specifically designed to determine mathematics readiness; such a tool would be helpful for instructional planning.

As a Kindergarten teacher, I appreciate the value of assessing students frequently and regularly. This allows me to identify misconceptions and proper conceptions that the children may either have achieved or are developing. Most assessment tools readily available to Kindergarten teachers are designed to evaluate social or language development. There are very few resources available for assessing Kindergarten children’s mathematics development, and currently, no formal mathematics assessments are available to Kindergarten classroom teachers in the Halifax Regional School Board. In researching the literature on children’s readiness for school, I was surprised to find a lack of research studies devoted to mathematics readiness, and therein lay my interest for this thesis project. Informed by the existing research, by my own experience as a Kindergarten teacher, and by my growing background as a mathematics educator, I have devised a survey that aims to learn of Kindergarten teachers’ perceptions of their personal preparedness for instruction and assessment, as well as their students’ abilities in mathematics and literacy. In contrasting teachers’ perceptions of Kindergarten students’ literacy and mathematics readiness results of the study have implications for future research

for the development of a common mathematics readiness assessment. Participants' feedback provides current information on how individual Kindergarten teachers assess mathematics readiness, and indicates that a Kindergarten mathematics readiness tool could be beneficial for year-long mathematics planning and instruction. This study provides important insight into the type of tool that would provide teachers with the necessary information to help them plan more effectively, improving and informing their instructional practices.

Chapter 1: Statement of the Problem

Introduction to the Chapter

Whether informally or formally, there exists a need for assessing mathematics readiness. This is due to the academic expectations of Kindergarten and the diverse prior experiences of students. Teachers are responsible to help students meet all of the outcomes and to ensure students' mathematical understanding. Many Kindergarten teachers are currently accomplishing the task of assessing mathematics readiness without standardized external guidance. This study aims to discover strategies teachers currently use to assess mathematics readiness and to determine whether a standard mathematics readiness assessment is needed.

The Problem

There are several studies that focus on general school readiness (Coates, 2004; Datar, 2006; Doherty, 1997; Gredler, 1992; Gillis, 2007; West, Meek, & Hurst, 2000). Research on mathematics readiness is limited and mostly focused on numeracy (BC Ministry of Education, 2003a; Aubrey & Godfrey, 2003; Nicol & Kelleher, 2004; Denton & West, 2002; Clarke, Rowley, Gervasoni, Horne, McDonough, & Cheeseman; Clarke, et al., 2001; Ginsberg & Russell, 1981). By surveying Kindergarten teachers on their current readiness assessment techniques in literacy and in mathematics readiness, I can contrast the support provided for Kindergarten teachers in these two curriculum areas, and determine the support that is needed. I believe that literacy readiness is well supported, but that mathematics is less supported and requires additional resources; whether a standard mathematics readiness tool would be useful will also be determined based on participants' responses. Information on how teachers are informally assessing readiness was collected and could serve to develop a mathematics readiness tool in a future study.

Purpose of the Study

The purpose of surveying Kindergarten teachers was to determine if teachers perceive less support for mathematics readiness than literacy readiness, and how individual teachers currently assess their students' mathematics readiness; results indicate that there is a perceived need for a common mathematics readiness assessment tool. Kindergarten teachers are careful observers; they strive to determine the readiness of their students and to devise supportive environments in which all children can succeed. In light of teachers' assessment practices, a comprehensive and informative mathematics readiness tool could be developed and tested in a subsequent study. In shortening the "roaming" time, that is, the time it takes to assess each individual student's prior mathematics knowledge a Kindergarten teacher must endure at the beginning of each school year, a teacher would be able to teach to meet the Kindergarten outcomes more effectively. Instructional planning that is based on meeting the children where they are in their understanding of mathematics results in the students *meeting* the outcomes, not merely *covering* the topics involved in the outcomes.

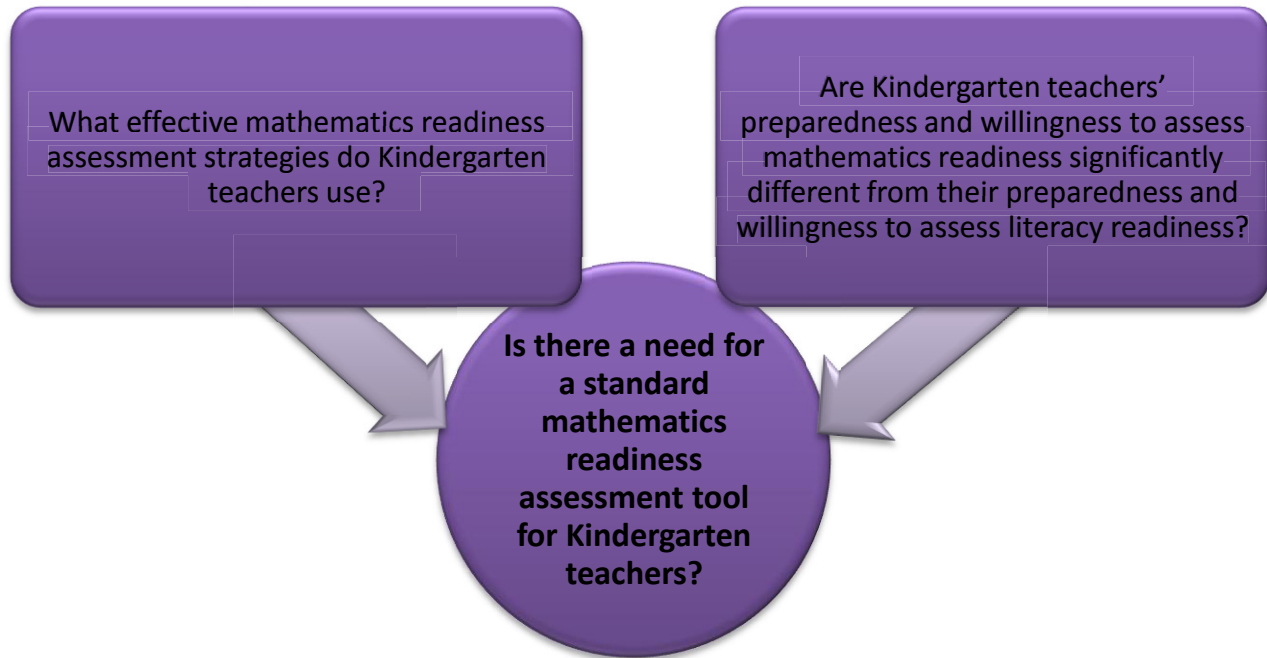
The survey collected information on two areas of school readiness: literacy and mathematics; this is to provide a context for comparing teachers' perceptions of mathematics readiness to another dominant curriculum area. Ultimately, the purpose of the survey was to gather information on the teachers' assessment of their students' prior knowledge necessary for meeting Kindergarten mathematics outcomes and to determine whether they desire or require support in determining students' readiness for Kindergarten mathematics instruction. The Halifax Regional School Board uses a literacy assessment in Kindergarten and early elementary grades, *An Observational Survey of Early Literacy Achievement* (Clay M. M., 1995), to assess readiness and to monitor student progress with respect to concepts about print and reading achievement. Clay's work is field-tested, informative and based on Clay's own empirical research from the 1960s. At that time, there was a theory that children learned to read by beginning with the book itself, as opposed to beginning with phonetics. Clay was the

first researcher (Clay, 1966; Mowat, 1999) to collect empirical research data on how children read using a method that eventually became known as *Reading Recovery* with a longitudinal study with 100 five year olds (Clay M. M., 1967). Some critics (Grossen, Coulter, & Ruggles, 1997) do not believe that Clay's work, particularly the expensive and specialized program *Reading Recovery*, is based in empirical research since researchers associated with Reading Recovery typically exclude 25-40% of the poorest performing students from their data analysis (Baker & al, 2002). Nonetheless, components of this literacy assessment tool is invaluable to practicing teachers due to its concise, consistent, and efficient method and analysis, especially the cost-effective and efficient instrument "Running Records." No such mathematics tool is at this time available in Maritime schools. I believe that a mathematics readiness tool can be empirically researched, developed, and piloted for use in Kindergarten classrooms, and this teacher survey on student mathematics readiness provides direction for its development in a subsequent study.

Research Questions

I believe Kindergarten teachers assess mathematics readiness with less focused importance than literacy readiness. Further, I suspect that Kindergarten teachers who do assess mathematics readiness do so very informally and do not have access to formal mathematics readiness assessment tools. I believe Kindergarten teachers are less prepared to assess and monitor mathematics readiness and achievement than literacy and general readiness and achievement. This study provides research to justify the need for a standard mathematics readiness assessment tool for Kindergarten teachers (see Figure 1: The Research Problem).

Figure 1: The Research Problem



Significance of the Study

This study fills a significant void in the teaching of mathematics for understanding. Without the ability to assess effectively and efficiently where the students in Kindergarten are *coming from*, a teacher cannot determine where the students *are* in their understanding of mathematics, nor can they easily and quickly determine the most beneficial way to *move them forward*. Every year, Kindergarten teachers, both novice and experienced, are faced with assessing literacy readiness and mathematics readiness. There is an abundance of provincial and board supports for literacy assessment and instruction, but there is a lack of equivalent supports for mathematics. This is not to say that literacy is not an important curriculum area; rather, literacy is well-researched and well-supported in practice. Mathematics is missing significant research in readiness at early elementary grades, and more importantly, studies that do provide important results and guiding information do not always find their way into the classrooms. This teacher survey on practices and perceptions of readiness assessments will provide the information needed for future development of a mathematics readiness assessment tool.

Assumptions and Limitations

Participants were teachers, in a variety of teaching assignments, currently enrolled in a graduate education programme. Data on mathematics and literacy readiness was collected through an online survey. One major assumption is that teachers were honest about their true assessment practices and beliefs regarding the academic readiness of incoming students. The data and subsequent analysis of the data are applicable to the sample of teachers, and generalization of the results is limited to Nova Scotian graduate students, the demographic secured in the recruitment process.

Conclusion to the Chapter

This chapter presented the problem under examination: Kindergarten teachers' knowledge of incoming students' mathematics readiness. For statistical analysis purposes, information was collected on literacy and mathematics readiness; data was analysed with mathematics readiness as the focus. To secure a large sample, teachers in a variety of positions completed the survey, and Kindergarten teachers (along with participants who indicated that they have previously taught Kindergarten) were isolated for analysis purposes. The purpose of surveying teachers was to determine how individual teachers currently assess their students' literacy and mathematics readiness and whether there is, indeed, a gap in resources available to support mathematics and literacy assessment and readiness; this information allowed me to determine whether there is a perceived need for a common standard mathematics readiness tool. The next chapter provides a review of the literature relevant to the broad field of school readiness, the specific research on mathematics readiness and achievement, and research relevant to the theoretical framework.

Chapter 2: Literature Review and Theoretical Framework

Introduction to the Chapter

The first chapter outlined the problem under examination in this study: Kindergarten teachers' knowledge of incoming students' mathematics readiness. In this chapter, through a literature review, I examine school readiness, mathematics readiness, assessment practices in elementary school, and the effectiveness of teachers' perceptions of necessary indicators for academic achievement. There has been research conducted in the area of elementary mathematics instruction and learning, as well as school readiness. In fact, there is a large body of research specific to numeracy readiness. However, there is little research specific to mathematics readiness that is pertinent and readily accessible to all practicing Kindergarten teachers; the Halifax Regional School Board is one example of a school board in need of further support for its teachers. That is to say, there is no research-based teacher-friendly mathematics readiness assessment tool or guide available for all Kindergarten teachers.

First, I provide an overview of classical and contemporary research in the area of general school readiness. I begin with research on developmental readiness, as this is the beginning of child readiness in formal research studies. I provide an overview of Piaget's theories about child development. Though, some of Piaget's theories can be perceived as out-of-date, many contemporary developmental researchers look to Piaget as a starting point in their own research, and have continually added to the body of knowledge on developmental readiness. I also summarize relevant research on Developmental Appropriate Practice. Many educational movements are based on teaching and learning developmentally, which can be appropriate for many curriculum areas, particularly during the early elementary school years. As such, I also provide an overview of genetic impacts on developmental readiness. Other important influences on a child's school readiness are factors such as race, culture,

socio-economics, prior experiences, and parental concern and involvement. Children have many influential factors outside of the school environment that may be either a challenge to or an advantage for school readiness. For this study, I developed a survey that aims to evaluate teachers' perceptions of school readiness, and I expect these factors may influence teachers' consideration of a child's readiness to learn.

The second research area I examine in this literature review is mathematics readiness. I also examine general and literacy readiness to provide a framework for the study since data on teachers' perceptions of mathematics readiness is put in context by comparison to literacy readiness. The developed survey includes questions on literacy and mathematics readiness: I am interested in comparing and contrasting teachers' perceptions and methods for assessing mathematics readiness with those used for literacy readiness. Throughout much of the research on school readiness, the focus is on determining developmental milestones and pre-literacy experiences. Mathematical readiness is rarely included in school readiness studies, and when it is, it is usually only a small component of an entire study. Likewise, in practice, teachers are provided with many tools to assess developmental and literacy readiness and achievement, but none in Nova Scotia are tailored to assess mathematics readiness and monitoring. Mathematics is often erroneously limited to only numeracy, with particular focus on operations and conventional algorithms, as opposed to mathematical understanding within all of the mathematical strands: number sense and operations, patterns and algebraic thinking, geometry, measurement, data management and probability. Numeracy undoubtedly does encompass many mathematical concepts, and can be linked to many other areas of mathematics; however, it should not be the only focus of early elementary mathematical research. An imbalance can be expected to favour numeracy, but the disregard of the other important areas of mathematics makes compiling a compelling literature review challenging. As a result, a disproportionate weight to early number concept research is reviewed in this chapter, from influential thinkers in the area of mathematics readiness and learning,

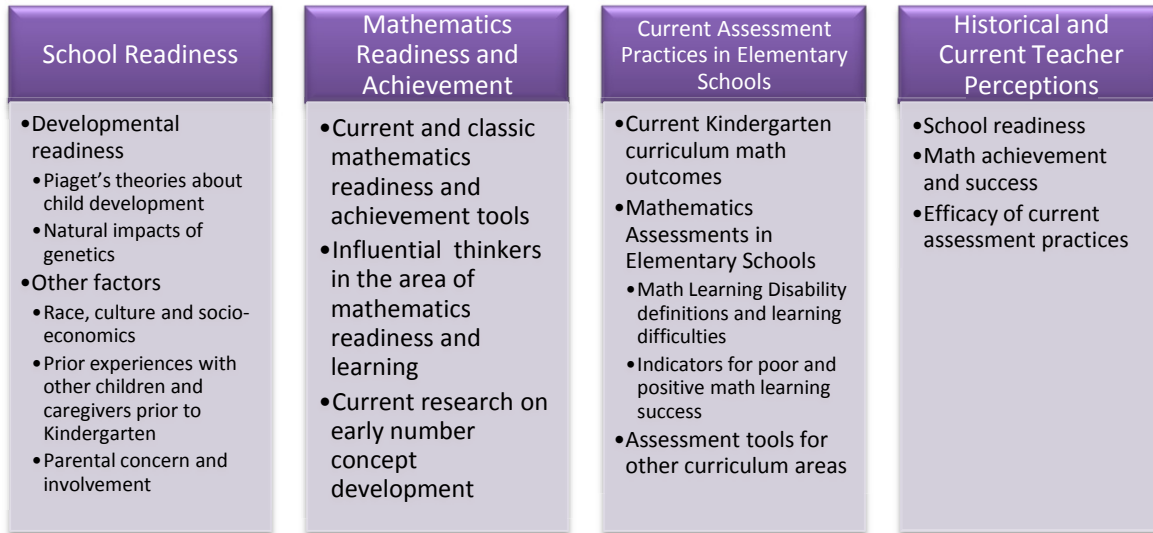
including early theories by individuals such as Piaget and Dienes, to current research being conducted in this area. An overview of the emerging research area of Mathematics Learning Disability is provided because some qualities relevant to Mathematics Learning Disability identification may also be linked to readiness. Indeed, in reviewing the indicators for Mathematics Learning Disability and learning difficulties, the prerequisites for readiness can be better understood. Mathematics Learning Disability identification and prediction techniques may have important implications for the future development of a Mathematics Readiness Assessment in a subsequent study.

Since this study collected data on teachers' perceptions of readiness and current practices in assessing readiness, a review of research on the efficacy of current assessment practices in elementary schools, including general academic, developmental, and mathematics assessment is in order. The focus of the study is mathematics readiness in particular, so a review of current Nova Scotia Kindergarten mathematics outcomes is provided.

Since this study collected data in survey form, and surveys have a tendency to reflect attitudes and beliefs as opposed to an objective reflection of classroom reality, I review survey-based research in the areas of school readiness, mathematics readiness and achievement, and the efficacy of current school assessment practices. This area of the literature review directly impacts the development of the theoretical framework, the development of the Kindergarten teachers' survey, and the subsequent interpretation of the results.

The literature review for this study centres around four main research areas: school readiness, mathematics readiness and achievement, current practices in elementary schools and historical and current teacher perceptions on these areas (see Figure 2: Literature Review Summary). This literature review presents the research that is the basis of this study and places this study in context with other research conducted on mathematics readiness and the areas related to it.

Figure 2: Literature Review Summary



School Readiness

The Canadian government has provided a summary of ten government reports on school readiness which indicates that early childhood experiences can impact a child’s readiness for school and school success (Coates, 2004). It acknowledges a lack of research on the interaction of the many variables that influence a child’s early childhood experience. The Canadian government also funds a study on the early years of life and its implications for school readiness (Human Resources and Social Development Canada, 2007b; Human Resources and Social Development Canada, 2007a) which collects information from parents, teachers and children. The Understanding the Early Years project focuses mostly on prior experiences, development, health, and communication. Mathematics is limited to number knowledge only. The difficulty in researching early childhood experiences, and how it may influence school readiness, is that while there seems to be some correlation between several variables that are present in a child’s experience prior to school, it is very difficult to measure and isolate the variables. This study contributes to the research focused on mathematics readiness, by highlighting effective teacher practice used by Kindergarten teachers with an online survey to determine whether a standard mathematics readiness tool would be useful.

In Canada, public school is a provincial jurisdiction, with some federal support, such as the Department of Citizenship and Immigration for First Nations peoples, and the Department of Northern Affairs and Natural Resources for North West Territorial Education (Council of Ministers of Education, Canada, 2008). Kindergarten or its equivalent is offered in most provinces and territories. Kindergarten is defined as the year preceding Grade One (Alberta Education, 2008). There is a collaboration that has existed in the western part of Canada for provincial cooperation to create a strong and comprehensive curriculum between the provinces of Alberta, Saskatchewan, Manitoba, and British Columbia along with the Yukon and Northwest Territories (Alberta Education, 2007). Entry age criteria are set at the board level and may vary, but, generally, all children who are six years of age on September 1 are required by law to be enrolled in school: so Kindergarten, by definition, would be for children under six years old. Many western boards involved in this provincial cooperation allow children to enrol in Grade One if they are six by March 1 of the following year, so Kindergarten children could be four years old until March 1 (Alberta Education, 2007). In Nova Scotia, Kindergarten is referred to as Grade Primary; in Ontario, Junior and Senior Kindergarten are offered, where Junior Kindergarten is synonymous with pre-Kindergarten and Senior Kindergarten with Kindergarten. Some Kindergarten programmes are delivered only on half-days, but are a full school day in Nova Scotia, in New Brunswick and in Quebec (Early Childhood Learning Agency, 2008). Prince Edward Island is considering moving from half-day Kindergarten (the only programme of its kind in Canada not managed by the provincial education department) to full-day programs (Canadian Broadcasting Corporation, 2007). Ontario is planning to provide full-time programming for four and five year olds, and British Columbia is considering full-day programming for three- and four-year olds (Early Childhood Learning Agency, 2008). So, generally, Kindergarten is for Canadian children aged 4 to 6 years, with varied cutoff birthdates. The date of mandatory entry to formal school, that is to say, Kindergarten or first grade, varies from 4 to 7 years of age, depending on the province or territory. Parents who may feel that a child would benefit from one

extra year at home or an alternate setting is not required to register a child for school before the mandatory entry date, dictated by provincial law. In the fall of 2008, Nova Scotia moved the minimum eligible cutoff entry birth date for entry to Grade Primary from October 1 to December 31, which is consistent with most provinces and territories. This means that children who turn five years of age on or before December 31 of the year of entry are eligible for Primary/Kindergarten enrolment (Government of Nova Scotia: Department of Education, 2008). Prince Edward Island will also make this change for Kindergarten enrolment by 2009 (Government of Prince Edward Island, 2008).

Indeed, in a single country, like Canada, there can be great variation and debate over the eligible age for entry to Kindergarten. Age, however can be an unreliable indicator for school readiness because children do not all develop at the same rate and have varied prior experiences (Stipek, 2003). In fact, studies have shown that while being relatively older than other classmates may have a slight advantage during the Kindergarten year, the advantage is diminished or nonexistent by the end of the Kindergarten year, and almost certainly by mid- to late-elementary (West, Meek, & Hurst, 2000; Lincove & Painter, 2006), even if differences were observed initially in September of the Kindergarten year (Spitzer, Cupp, & Parke, 1995; Kinard & Reinherz, 1986; Oshima & Domaleski, 2006). Other studies find that delaying entry to Kindergarten by a year for children who are eligible but not required to register can increase early elementary performance (Datar, 2006) or late elementary school performance (Crosser, 1991; Borg & Falzon, 1995). Datar (2006) also notes that for children who are at-risk, delaying entry to school can have significant impact on positive academic performance.

Developmental Readiness

Developmental readiness can certainly be a function of age, but age is not a true predictive factor for readiness. In fact, Piaget's theories about learning and development are sequentially defined, but the age thresholds he indicates are general and vague, and were not included in his original

publications, but were added in translations to English (Piaget, 1952; 1972). It is known, however, that Piaget's participants were carefully documented in his personal notes, often with ages noted to the month, so the age guidelines emerge from his research notes. Piaget did not intend his work to be interpreted based solely on age thresholds, but rather on the sequential order of the developmental stages. The age thresholds may actually be out-of-date and inaccurate because contemporary young children are capable of accomplishing tasks and demonstrating concepts that could only occur in later Piagetian stages (Sriraman & English, 2004). The biological factor, age, is important to child development, due to two Piagetian concepts called duration and succession, and Piaget was more focused on the process of *how* children learn than determining *when* children learn. Piaget compares the lengthy development period of human childhood to other animals' period for growth to illustrate the importance of duration: humans have more to learn and spend a longer time in childhood (Piaget, 1972). The development that has taken place before formal school begins is integral and directly linked to the success that a child will experience in the first year of school (Coates, 2004).

The notion of developmental readiness is certainly one of the key reasons why teaching children in their first year of formal school is challenging. The diversity of individual students' developmental levels and prior experiences is a challenge for early elementary teachers, more so than for upper elementary and secondary teachers (Bodrova, Paynter & Leong, 2001). While developmental variance certainly still exists in other grade levels, the children do tend to assimilate once formal school begins, as experiences are rich with academic objectives and expectations for learning are set. Of course, given the challenging material for student achievement, I am sure some teachers would argue to the contrary: managing students can seem to get more difficult to manage in later grades with diverging achievement, and the need for upper elementary teachers to balance student attention difficulties, learning styles, Individual Program Plans, formal Adaptations, and the like.

Indeed, there is no definitive age at which all children are “ready” for the next developmental stage, but the majority of children will likely fall into the general thresholds that Piaget has determined (Piaget, 1952). The idea of developmental *succession*, however, is more relevant to this study. Teachers operate with the understanding that there are successive stages to learning mathematics. Certain mathematical concepts precede increasingly complex concepts. Conceptual readiness, I would argue, may be more important for curriculum planning than developmental readiness. I believe that there is a need to shift thinking from that of waiting for students to be ready to that of providing them with meaningful and conceptual experiences on which to build mathematical understanding, respecting the limits of developmental readiness for certain skills or understandings. Kindergarten teachers can determine students’ readiness for learning by assessing the prerequisites to the Kindergarten outcomes. School administration or government determines a minimum age requirement for school instruction, and this entry age is based on the calendar year, not each child’s individual development schedule, or prior experiences. Some children will come to school in September ready to learn the grade level material, others would have been ready to attend class months earlier, and still others may not be ready until a later point in the Kindergarten year. A Kindergarten teacher must teach all students, ready or not; if a child is not ready, the hope is that the teacher will provide a rich environment in which the child can prepare to learn with meaningful conceptual activities that precede and provide foundation for the concepts expected to be mastered in Kindergarten.

Developmentally Appropriate Practice is a pedagogy that is prevalent in early childhood centres, and, indeed, is consulted for Kindergarten age children as well (NAEYC, 2009). Developmentally Appropriate Practice approaches child education from three areas: what is known about child development and learning (i.e. age-related characteristics), what is known about the child as an individual, and what is known about the cultural and social contexts in which a child lives (NAEYC, 2009). *Developmentally Appropriate Practice* (Copple & Bredekamp, 2009),

is an approach to curriculum not curriculum itself such as the Head Start Framework. It calls upon the teacher to make sure that the daily activities and environment provide engaging, learning experiences for every child in the classroom. In order to encourage such optimal experiences, the teacher should possess the professional knowledge of child development, early learning standards (what children should know and be able to do), and how young children learn in general, as well as the awareness of the developmental skills, learning abilities and diverse socio-economic, cultural, linguistic and familial influences of each individual child. Therefore, in a DAP classroom, a teacher's nurturing disposition is welcomed but is not enough. Instead, this loving of children should act as the spur that pricks the sides of the teacher's intent to make the professional decisions necessary for the education and guidance of children, both as individuals and as a group of learners---decisions based on age, individual, and cultural appropriateness. This professionalism is key to best practices in the classroom. It is what makes teaching young children an awesome challenge and wondrous privilege for the DAP intentional teacher who every day manages an active mix of child-guided and teacher-guided learning experiences to bring fun, joy and wonder to each child's early learning development (Mesrobian, 2009).

The National Association for the Education of Young Children notes that mathematics is integral to school readiness, and supports research that indicates that predictors of math learning can be observed in preschoolers' knowledge of numbers and number sequence, but that mathematics is not given much attention prior to Kindergarten. NAEYC suggests that early childhood educators lack the knowledge, skill and comfort level necessary to "substantially and effectively increase their attention to mathematics in the curriculum" (NAEYC, 2009, p. 7), and provides guidance for early childhood

educators and policy makers (see Table 1: Summary of Recommendations for Early Mathematics Education (NAEYC and NCTM, 2002)).

Table 1: Summary of Recommendations for Early Mathematics Education (NAEYC and NCTM, 2002)

In high-quality mathematics education for 3- to 6-year-old children, teachers and other key professionals should

- 1. enhance children’s natural interest in mathematics and their disposition to use it to make sense of their physical and social worlds
- 2. build on children’s experience and knowledge, including their family, linguistic, cultural, and community backgrounds; their individual approaches to learning; and their informal knowledge
- 3. base mathematics curriculum and teaching practices on knowledge of young children’s cognitive, linguistic, physical, and social-emotional development
- 4. use curriculum and teaching practices that strengthen children’s problem-solving and reasoning processes as well as representing, communicating, and connecting mathematical ideas
- 5. ensure that the curriculum is coherent and compatible with known relationships and sequences of important mathematical ideas
- 6. provide for children’s deep and sustained interaction with key mathematical ideas
- 7. integrate mathematics with other activities and other activities with mathematics
- 8. provide ample time, materials, and teacher support for children to engage in play, a context in which they explore and manipulate mathematical ideas with keen interest
- 9. actively introduce mathematical concepts, methods, and language through a range of appropriate experiences and teaching strategies
- 10. support children’s learning by thoughtfully and continually assessing all children’s mathematical knowledge, skills, and strategies.

To support high-quality mathematics education, institutions, program developers, and policymakers should

- 1. create more effective early childhood teacher preparation and continuing professional development
- 2. use collaborative processes to develop well-aligned systems of appropriate high-quality standards, curriculum, and assessment
- 3. design institutional structures and policies that support teachers’ ongoing learning, teamwork, and planning
- 4. provide resources necessary to overcome the barriers to young children’s mathematical proficiency at the classroom, community, institutional, and system-wide levels.

“The research base for sketching a picture of children’s mathematical development varies considerably from one area of mathematics to another. Outlining a learning path, moreover, does not mean we can predict with confidence where a child of a given age will be in that sequence. Developmental variation is the norm, not the exception. However, children “do tend to follow similar *sequences, or learning paths, as they develop*” (NAEYC and NCTM, 2002, p. 27). Please consult Appendix B: Developmentally Appropriate Practice- Learning Paths and Teaching Strategies in Early Mathematics. Some DAP

researchers (Kaul, Bhatnagar, & Tolani, 1991) propose that some current mathematics curriculum expectations are excessive and not developmentally appropriate, and caution against academic priorities and the limits on child development.

In addition to concern about variation in child development and the negative ramifications that may occur when documenting standards for such young children, advantages and disadvantages to having standards-based outcomes for early childhood education programs also indicate concern that standards could lead to “inappropriate teaching of narrowly defined skills (Bredekamp, ND). Bredekamp acknowledges research that indicates what children of a certain age *can* do, but challenges policy makers and curriculum developers to consider that children of a certain age *should* do. When outcomes are written as skills, and will be assessed by skill demonstration, teachers who are not prepared for mathematics instruction resort to teaching to the test or memorization rather than teaching conceptually. “Providing guidance about appropriate mastery goals for children’s learning is especially crucial in the area of mathematics where teachers’ own knowledge of the discipline is usually inadequate to make these judgments” (Bredekamp, ND, p. 3). I believe that skills are measurable indicators of a concept, and by teaching conceptually, skills will emerge and be honed. I believe that teaching skills (or outcomes) out of context can lead to misconceptions, as students are encouraged to memorize and perform rather than reason and understand. It is very good news for early mathematics educators that the National Council of Teachers of Mathematics and the National Association for the Education of Young Children team up to examine these critical issues (NAEYC and NCTM, 2002).

The current mathematics curriculum in Nova Scotia, and in most Canadian jurisdictions, is based on the NCTM *Curriculum and Evaluation Standards for School Mathematics* (National Council of Teachers of Mathematics, 1989). The publication of the *Standards* came at a precise moment in the history of mathematics, and propelled a reform in mathematics education: mathematics was to be

standardized across America (and other nations adopting the recommendations, such as Canada) for “equity” and not “excellence” (Schoenfeld, 2004). A field of study once thought to be reserved for the academic elite became accessible to all. The math wars that began with the introduction of the *Standards* are between traditionalists, who support the classical mathematical values and openly opposing the standards, and the reformists, who believe promote deeper and richer mathematical views (Schoenfeld, 2004). Schoenfeld likens the Math Wars to the Reading Wars (phonics versus Whole Language):

Any sensible person would realize that children need both phonics and reading for understanding. Either of the two perspectives, taken to extremes, is nonsensical. The polarization that resulted in a “winner take all” battle between the two extremes is equally nonsensical. The same is the case in mathematics. An exclusive focus on basics leaves students without the understandings that enable them to use mathematics effectively. A focus on “process” without attention to skills deprives students of the tools they need for fluid, competent performance. The extremes are untenable (Schoenfeld, 2004, pp. 280-1).

The *Standards* (1989) follow a tumultuous history in mathematics with the New Math era (corresponding to the beginning of space exploration) and the Back to Basics movement of the 1970’s. The basics of mathematics resulted in students having low problem solving ability, and measures of mathematical abilities were worse than pre-Sputnik times. The 1980’s was ushered out with the publication of the NCTM *Standards* (1989), which still influences contemporary mathematics curriculum development. Recommendations from the expert analysis of the 2008 Final Report from the National Mathematics Advisory Panel are to have effective mathematics instruction in the early grades when children are ready to be introduced to mathematical concepts. Recommendations focus on K-8

mathematics curricula, not secondary curricula; a strong mathematical foundation is required for sophisticated mathematical understanding, problem-solving and abstract concepts:

Most children acquire considerable knowledge of numbers and other aspects of mathematics before they enter Kindergarten. This is important, because the mathematical knowledge that kindergartners bring to school is related to their mathematics learning for years thereafter—in elementary school, middle school, and even high school (National Mathematics Advisory Panel, 2008, p. 18).

It is imperative that curriculum begin to acknowledge the abilities of our youngest students. They must be given opportunities to be exposed to and actively learn mathematical concepts when their brain is ready:

Teachers and developers of instructional materials sometimes assume that students need to be a certain age to learn certain mathematical ideas. However, a major research finding is that what is developmentally appropriate is largely contingent on prior opportunities to learn. Claims based on theories that children of particular ages cannot learn certain content because they are “too young,” “not in the appropriate stage,” or “not ready” have consistently been shown to be wrong. Nor are claims justified that children cannot learn particular ideas because their brains are insufficiently developed, even if they possess the prerequisite knowledge for learning the ideas (National Mathematics Advisory Panel, 2008, p. 20).

Other Factors

Many school readiness studies seem to focus on prior experiences, along with other factors, such as biological dispositions, race, culture, and socio-economic status (Diamond, Regan, & Bandyk, 2000; Doherty, 1997; Coates, 2004; Ginsberg & Russell, 1981; Thomas, 2006). These factors may have

an impact on a child's family situation. The general sense from the literature is that *how* a child's family deals with these factors, and the experiences that the family and community provide to the child in the first years of life are more influential, and have the greatest impact on the child's potential for school success (Coates, 2004; Thomas, 2006). Even a child in a situation with seemingly poor factors can have a successful start to school with a guardian-parental unit committed to providing meaningful pre-school experiences.

Data from the National Household Education Survey (1993), conducted in the United States, indicates that parents of a visible minority (African American, Hispanic and others) were significantly more likely than Caucasian parents to worry about their child's readiness for formal school, but Caucasian parents were more likely to consider delaying entry to Kindergarten until later. Parental concern for school readiness was not related to learning activities and educational television shows viewed at home (Diamond, Regan, & Bandyk, 2000). In this same study, researchers identified parental concern for school readiness as the dependent variable. Family background, child characteristics, and home activities were the independent variables. Results showed that family background (race, ethnicity) and child characteristics (age, academic and behaviour skills) contributed significantly to readiness, but that home activities were not significant contributors to readiness. Results from Diamond et al.'s (2000) study are not consistent with other studies (Coates, 2004; Thomas, 2006) that indicate that parental involvement is a more reliable indicator for school readiness. Societal decisions affect community resources that may be available to parents of young children and can influence family income (for example, high cost of childcare may result in a parent choosing to stay home). Both family income and community resources affect parents: the amount of parental time available to the child, the level of parental stress, and the parenting behaviour, all have a direct impact on the child's development and school readiness (Doherty, 1997).

When English as a Second Language (ESL) students are entering Canadian schools, there is a language difficulty to overcome in addition to other possible factors. A study at the University of Toronto by Pelletier and Corter of the university's Institute of Child Study, indicates that children in their school readiness program were more prepared for school than other ESL students who did not have any preschool experience, and parental involvement with these ESL students was a contributing factor to positive school readiness (Toye, 2005).

Other school readiness factors are biological. While there are certainly some extenuating situations that will influence school success, this project did not anticipate ability to survey teachers on their strategies for assessing children entering school with exceptional biological, physical, or learning difficulties. Kindergarten teachers in Nova Scotia are not required to be qualified to diagnose such exceptionalities; educational psychologists are qualified to administer, score, interpret, and report psycho-educational assessment (Halifax Regional School Board, 2006). Studies on early screening (Coates, 2004) claim that timely intervention for children with developmental delays, mental health concerns, or family risk factors are minimal. As a result, some preventable situations are not detected until school entry (or sometimes after initial enrolment). Upon detection, diagnoses or suspicion of potential diagnoses, adaptations and interventions are necessarily more intense, invasive, long-term and costly, both financially and with human resources (Coates, 2004).

There is a movement for better quality, full-day pre-school programs (Early Childhood Learning Agency, 2008). Families with sufficient resources have access to private preschool, whereas less fortunate families cannot afford the same preschool programs, resulting in a performance gap even before formal schooling (Weast, 2001). In a US Study, the majority of children enrolled in state-funded pre-Kindergarten programs were from less affluent families or were children at risk of learning delays, resulting in 53% of enrolled children from families earning only slightly more than the US federal poverty

guideline (Clifford, Bryant, & Early, 2005). While one certainly understands the efforts of governments to make pre-school opportunities available to all children, the quality of the programs for these low-income families may not be high enough to close the socio-economic gap. Race, culture, and socio-economic status may play a role in a child's school readiness, but many obstacles that these factors may present can be overcome by guardian-parental involvement and their commitment to the child's success (Coates, 2004; Thomas, 2006). Of course, the simple presence of a pre-school program in the child's short history does not indicate an academic-rich environment. A study made by the National Center for Early Development and Learning in 2001, looked at 240 state-funded pre-Kindergarten programs in six states. There was indication that process quality was less informed than more quantitative structural and measurable qualities such as class size, teacher and administrator training, length of the day and year, use of a standard curriculum, and availability of supplementary services (Clifford, 2005).

Stipek's study (2003) focuses on the idea that age is not a major factor in school readiness, but that experiences are the main indicators of success, with educational experiences clearly making a positive impact on the child. A child in a stimulating, learning-rich environment will likely be more prepared for school than an age-mate without similar rich experiences. Children tend to grow more in school than out of school: "the effect of a year in school [is] twice the effect of a year of age (Cahan & Cohen, 1989)" (Stipek, 2003). This, arguably, can be achieved without formal preschool participation, and rather with an interactive, loving, enriched home environment focussed on readiness for learning.

Mathematics Readiness

In the course of my research, I have not found sufficient specific research on general mathematics readiness. However, there is research on children's numeracy readiness and children's learning. In this section, I will review theories and current research on number concept development and how this relates to numeracy readiness.

Influential Thinkers on the Topic of Mathematics Readiness

Beliefs about how children learn are subjective and are integral to how a teacher teaches. Teachers may have many different beliefs about mathematics achievement and success. In this section, I outline theories on how children learn mathematics, and in particular number (see Appendix C: Influential Thinkers and Their Theories on Mathematics Readiness and Learning), as I believe that teachers intuitively lean toward one or more of these theoretical frameworks, even without familiarity with these thinkers in the area of education, child psychology, and mathematics. An overview of these influential thinkers is warranted because it is my belief that teachers borrow from one or more of these thinkers in creating a personal teaching philosophy, melding these great thinkers' ideas with personal experiences and truths.

Piaget (1896-1990) can be regarded as the first psychologist to document and to attempt to assess children's concept of number. Researchers have carefully considered the methodology of Piaget's work (1952), and while his tests are replicable and reliable, their validity has been questioned (Gelman, Meck, & Merkin, 1986). Essentially, by accepting Piaget's theory on the Conception of Number theory (see Appendix D: Piaget's Conservation of Number for a partial overview of his work), one must also accept that time, and to an extent, age, are factors in a child's development. Piaget's theory proposes the ability to pinpoint where in the sequence of development a child needs to be in order for math instruction to be effective. It is important to note that Piaget's work is developmentally based, not conceptually based.

Piaget's theory (1952) acknowledges the intensely important years of development that exist prior to formal schooling. The development that has taken place before school begins is integral and directly linked to the success that a child will experience in the first year of school. The five years of development are relevant, and within these five years, one can expect that certain developmental

milestones are achieved. While I would like to acknowledge that there are certain “age guidelines” that have been revealed with Piaget’s work regarding child development, I believe that the guidelines are just that. From research in this literature review, there is consensus that environmental, biological, and other factors also influence readiness for learning. There is no definitive age at which all children will be “ready,” but the majority will likely fall into the general threshold that Piaget has determined (1972; 1952). The idea of *succession*, however, may be more relevant to the idea of readiness. Some Kindergarten teachers have informal ways to measure or assess the substrata of the successive stages that a student will have achieved prior to learning from instruction for meeting Kindergarten number outcomes. Piaget believes that previous knowledge and development precedes newly constructed knowledge (Piaget, 1972). These teachers may strive to identify children who may lack certain prior experiences or the achievement of specific developmental stages that seem to be indicative as necessary for the meeting of Kindergarten math outcomes. Piaget’s work (1952) can be a starting point for many teachers when considering assessing readiness for mathematics learning.

In contrast to Piaget’s Theory of the Conservation of Number, Howard Gardner’s (1943-) theory of Multiple Intelligences (Gardner, 1983; 1999) focuses on an individual’s learning style, and is not dependent on time for duration or succession for development. Gardner’s theory (summarized, in part, in Appendix E: Gardner’s Theory of Multiple Intelligences and his Developmental Trajectory) is a careful assessment based on observation. However, Gardner himself attested that his theory cannot be tested for validity or reliability since it would be difficult to isolate one intelligence apart from other in an individual:

I once thought it possible to create a set of tests of each intelligence - an intelligence-fair version to be sure - and then simply to determine the correlation between the scores on the several tests. I now believe that this can only be accomplished if someone developed

several measures for each intelligence and then made sure that people were comfortable in dealing with the materials and methods used to measure each intelligence (Gardner, 1999, p. 98).

The normal population tends to have a diversity of profiles of the intelligences, and gifted individuals may have an exaggerated cognitive profile (as summarized in Deizmann & Watters, 2000). Virtually untestable, although some have tried (Shearer & Jones, 1994; Bordelon & M., 2005), Gardner's theory holds significant weight in educational circles since it has never been disproven (Gardner, 2006) and is widely accepted in practice, providing focus for teacher to reflect on their own teaching practice (Harvard Graduate School of Education, 2000; Smith, 2002, 2008).

Howard Gardner's theory of Multiple Intelligences (1999) proposes a natural four stage Developmental Trajectory for each intelligence (consult Appendix E: Gardner's Theory of Multiple Intelligences and his Developmental Trajectory):

Gardner (1999) suggests that while all individuals have core abilities in each intelligence, across the population, individuals will range from those 'at promise' to those 'at risk' in particular intelligences. He argues that while it is not necessary for all individuals within a community to perform highly in particular intelligences, there is a need to identify those 'at promise' in order to advance knowledge in a particular domain. Gardner also argues for early intervention of those 'at risk' who are failing tasks associated with particular intelligences. In mathematics, the provision for those at risk generally only occurs for some notational tasks associated with logico-mathematical intelligence, with the view that the general populace needs to be numerate (Steen, 1997). (Deizmann & Watters, 2000, p. 304).

Teachers who adopt Gardner's view on how children learn keep multiple intelligences in mind when considering readiness for learning. If all children were expected to have core abilities in each intelligence, including mathematics, then assessing and fostering this intelligence for readiness would be of great importance.

One of the most progressive researchers in mathematics education is the developer of many common manipulatives found in classrooms around the world. Zoltan Dienes (1916-) believes in teaching mathematics with concrete and meaningful experiences using manipulatives (such as attribute blocks and multi-base blocks), games, stories, and dance. "Dienes championed the use of collaborative group work and concrete materials, as well as goals such as democratic access to the process of mathematical thinking, long before the words constructivism, equity, and democratization became fashionable" (Sriraman & Lesh, 2007, pp. 59-60). Following Dienes's guidance for teaching and learning mathematics, group work is never set up to be competitive, but cooperative, so that problems require students to work together. Dienes believes in allowing children to play with materials that will gradually introduce, expand, or solidify mathematical concepts. This is to say that Dienes directly challenged Piaget, a psychologist with whom he collaborated occasionally (Dienes, 2003), by defying the developmental theories and moving to conceptual theories for learning. Teachers who accept Dienes's ideas about learning mathematics (see Appendix F: Dienes's Six Stage Theory of Learning Mathematics) do not tell students directly what to do with the materials, but should use games and problems to help them discover concepts and patterns. Dienes emphasizes that formalization comes at the very end of this process. Dienes believes that premature introduction to written numerals and operation symbols are counterproductive:

Children do not need to reach a certain developmental stage to experience the joy, or the thrill of thinking mathematically and experiencing the process of doing mathematics. We

unfortunately do not give children the opportunities to engage in this type of thinking.

One of the first things we should do in trying to teach a learner any mathematics is to think of different concrete situations with common essence. (These situations) have just the properties of the mathematics chosen. Then... children learn by acting on a situation. Introducing symbolic systems prematurely shocks the learner and impedes the learning of mathematics (Sriraman & Lesh, 2007, p. 61).

Teachers who are teaching mathematics do not have to have lengthy academic careers in mathematics, but they must have depth of understanding. If the teacher lacks the understanding, then the students will not have meaningful experiences to develop the understanding, as the teacher will likely resolve to teaching mathematics as a “utility:” memorizing tricks, algorithms, and other information for regurgitation rather than applied problem solving. Structural knowledge, how mathematical concepts relate and fit into one another, is important to understanding. When the student does not have to rely on the teacher for tricks being taught, the student becomes an active learner. The nature of appropriate mathematics manipulatives, such as Dienes’s multi-base blocks or attribute blocks have the development of mathematical concepts built into their intention: “The nature of the materials determined the nature of play to some degree. So, even if we gave them no instructions at all, they could learn some principles as a result of interacting with the materials” (Sriraman & Lesh, 2007, p. 68). Dienes says: “I have never believed in a curriculum for young children. What matters is that children learn how to think” (Sriraman & Lesh, 2007, p. 71). Curriculum outcomes do exist, however, and teachers are obligated to assess learning. Primary and early elementary mathematics outcomes often involves “exploration,” which lessens the pressure of achievement; however, children are not often given opportunities to learn to think mathematically and to solve problems. Dienes’ notion of group work most closely promotes a problem-solving approach to learning because the learner is not attempting to replicate the teacher’s thought process: the learner is a group learning through

communication and interaction with each other and the materials. “One of the things that Piaget did not do, and that Dienes definitively has done, is to recognize that mathematics is not just about structure; but, more important, it is about isomorphism, homomorphism, and more generally structural mappings among structures (Sriraman & Lesh, 2007, p. 73).

The successive nature of the Van Hiele Levels of geometric thinking is reminiscent of Piaget, Gardner, and Dienes’ sequential paradigms. However, Dina and Pierre Van Hiele have determined five levels of geometric thinking for student learning (see Appendix G: Van Heiles’ Levels of Geometric Thinking) that are dependent on experience that come from the teacher’s careful selection of activities. In contrast, Piaget’s Conservation of Number was dependent on age and time, Gardner’s trajectory was “natural,” and Dienes’ stages of learning mathematics were constructed by the child; the Van Hieles propose that the child needs to experience activities specifically created by an adult to foster geometric thinking (Van Hiele, 1986).

There is a certain degree of assumption that Piaget had with development, in that the development of a child is natural and will occur regardless of external factors. However, other thinkers put emphasis on the environment that the child has spent the first five years of growth in, and specifically the human interactions that may have influenced the child’s present state of readiness to learn mathematics. “Both Piaget and Vygotsky believed in development and learning [...] Piaget believed that the level of development placed limits on what could be learned and the level of possible comprehension of that learning. Vygotsky, on the other hand, believed that learning culturally modeled concepts led to development. Thus, for Vygotsky, learning is the driving force of intellectual development, whereas for Piaget, development is the driving force” (Wadsworth, 1996). If a child is in learning-rich environments with adults and peers committed to providing children with interesting and

developmentally appropriate situations, one could conclude that the child is more prepared to meet the academic outcomes taught in Kindergarten.

Vygotsky (1896-1934) developed the theory of the Zone of Proximal Development (Vygotsky, 1978) which is incorporated into Clay's (1995) Running Record system (Mowat, 1999). Vygotsky's theory involves determining the difference between what a child can do independently and what a child can do with assistance. This difference is the "zone" where learning takes place. "Running Records" strive to find an instructional reading level for the child. A Running Record can be used to determine a child's reading level; a child's reading accuracy rate between 90 and 94% is defined as "instructional." Texts that a child can read with accuracy 95-100% of the time are considered easy, and could be used for independent practice. The texts that are in the Zone of Proximal Development are ideal for instructional practice. Texts, which are too difficult for a child to read at a given point in time, are below this Zone of Proximal Development (less than 89% accuracy rate), and would cause the child too much frustration for effective reading instruction to occur. This same theory can be used in mathematics. A child who has mastered a concept will learn little doing activities that do not challenge the student to apply the mathematics in a meaningful way; likewise, striving to teach at a level beyond a child's conceptual understanding will lead to frustration and may increase mathematics anxiety.

Theories and Current Research on Early Number Concept Development.

Historically, counting was a necessary skill, perhaps even before spoken or written language developed. Body part counting is a natural starting point for children. Indeed, other cultures, such as individuals in Papua New Guinea and the Torres Straits Islands continue this traditional form of counting. Knots and tallies are other ways to keep track of quantities, and can be used by young children as well (Box & Scott, 2004).

Young children can use number words without really understanding the mathematical meaning for the number names (Sarnecka & Gelman, 2004; Wynn, 1992). Usually, children begin by understanding “one”, and that all other numbers are “more;” similar to that of the singular/plural distinction. Approximately one year later, “two” begins to hold meaning with all other numbers meaning “more,” now similar to the singular/dual/plural distinction. (Sarnecka, Kamenskaya, Yamana, Ogura, & Yudovina, 2007) Children in different cultures have different experiences with number. Sarnecka, Kamenskaya, Yamana, Ogura, & Yudovina (2007) found that depending on the language, children seemed to interpret number names for one, two, and three as the singular/plural grammatical cue more than the mathematical meaning of the number name. Sfard and Lavie (2005) propose that communicating about number is motivating for the adult to teach and the child to learn. Often, children’s understanding of number is not immediately evident to adults superficially observing; nonetheless, even when a child seems to be setting into a ritual when discussing numbers and number meaning, learning can still be happening, and will eventually emerge for the adult to observe (Sfard & Lavie, 2005). Wynn (1992) conducted research with very young children on the acquisition of number words and has found that children learn the numbers to two or three sequentially. Young children understand that larger numbers refer to numerosities, but not necessarily which numerosity (for example, a child may use the term “one hundred” to refer to many items, but not exactly one hundred). The Chinese number names are more intuitive than the English number names, particularly numbers higher than 10. For example, “eleven” does not indicate that it is a ten and a one, whereas in Chinese eleven is actually called “ten and one.” Chinese children seem to master number names and the base-ten place value system more so than western children (Zhou, Wang, Wang, & Wang, 2006).

Three-year old children are able to recite ordered numbers at least to six, but meaning of these number words may take months longer to develop. Four-year old children have mastered meanings of smallest counting words, and their count list is limited to 20 or fewer (Wynn, 1992). Five-year old

children have knowledge of number words to which they can count reliably and also number words beyond their counting range. According to Lipton & Spelke (2006), children understand the logic of number word meanings before formalized schooling.

A study indicates that later numeracy scores do not appear to be dependent on school entry age, but rather on the richness of mathematics experiences, with a broad and balanced curriculum that emphasizes problem solving (Carol & Ray, 2003). Well-meaning, seemingly academic activities can result in superficial knowledge without interactive adult conversation about mathematics:

Learning mathematics requires that children create and re-create mathematical relationships in their own minds. Therefore, when providing appropriate instruction, teachers cannot be seduced by the symbolism of mathematics. Children need direct and concrete interaction with mathematical ideas; ideas are not accessible solely from abstraction. Continuous interaction between a child's mind and concrete experiences with mathematics in the real world is necessary (Burns, 2000, p. 24).

Superficial math experiences will become evident if the child appears to be able to regurgitate rote information (such as strands of sums, or a series of numbers) without being able to show understanding of the actual math concept (such as counting the number of items in a set, or knowing that the total amount is the last number said, when counting with one-to-one correspondence).

Children can develop skills and procedures before understanding concepts and principles. The curriculum, as well as the attitudes of many parents and teachers, still supports an emphasis on math skills and procedures. However, the development of students' concepts is vital for their understanding of mathematics (Rogers, 2007). Rogers continues with an example: children recognizing numerals or naming numbers is not an indicator for understanding the concept of numbers. Numerals alone (such as

those on flash cards) are abstract; numerals in everyday encounters (such as those on road signs) are usually in context, and carry more meaning.

Children's understanding of number can best be understood by careful observation by the teacher. In fact, the British Columbia Early Numeracy Project (BC Ministry of Education, 2003b) indicates that even a single task can provide a good indication of a child's numeracy proficiency (Nicol & Kelleher, 2004).

Mathematics Learning Disability Research

There is an emerging research area dedicated to Mathematics Learning Disabilities (MLD), and to determining early elementary predictors for later Mathematics Learning Disability or achievement. Indeed, this research dedicated to identifying predictors for difficulties or disabilities in learning and understanding mathematics informs research for determining readiness to learn and achieve mathematics understanding. My purpose in reviewing the area of Mathematics Learning Disabilities is to consider current elementary assessments for Mathematics Learning Disability and their effectiveness, since there is little research done specifically on mathematics readiness. By understanding research that exists in the area of *deficits* in mathematics understanding in elementary school, *success* and *readiness* for mathematics instruction can also be informed.

Of note is that the battery of tests used in Mathematics Learning Disability screening are not generally accessible to all Kindergarten teachers for all students. For example, all standardized tests for learning disabilities or used to determine achievement levels or deficits are accessible only to school psychologists and some resource teachers in the Halifax Regional School Board; furthermore, these tests are usually only administered to students with perceived deficits or exceptionalities. For this reason, data collected on informal mathematics readiness assessments are informative for developing a future mathematics readiness assessment tool, rather than adapting a specialized assessment that is only

accessible by specialists outside the Kindergarten classroom. I believe that how classroom teachers assess all students in the regular classroom informs effective teaching, which, in turn, results in meaningful learning for the students. By creating a division between informative assessments given by specialists outside of the classroom and the act of learning and teaching in the classroom, gaps can occur in student academic success. Immediacy of assessment results is required. Teachers need immediate results of assessments to tailor teaching and learning opportunities to the students. When students who qualify for specialists' screening for Learning Disabilities or achievement are tested with the standardized assessments, the specialists require time for analysing the assessment. For classrooms in the Halifax Regional School Board, it is not uncommon that results of administered tests are available to classroom teacher weeks or months following the assessment. In addition, Kindergarten students are rarely assessed by school psychologists. There are reluctance in assessing such young children during a rapidly developmental period, issues with the nature of the assessments, the unreliability and potential uninterpretable results that occur when using the standardized assessments with young children, and long lists of referrals from upper elementary teachers prioritized by schools' program planning teams. How Kindergarten teachers cope and adapt to the need for mathematics readiness assessments without external guidance was one of the goals of this study.

Selected Mathematics Learning Disability research articles (Mazzocco & Myers, 2003; Mazzocco & Thompson, 2005; Lachance & Mazzocco, 2006; Murphy, Mazzocco, Hanich, & Early, 2007; Teisl, Mazzocco, & Myers, 2001; Mazzocco M. M., 2005) were based on a single four-year longitudinal research project of children from Kindergarten through third grade.

Determining a Definition for Mathematics Learning Disability

Murphy, Mazzocco, Hanich and Early (2007) examined whether cognitive characteristics of children with Mathematics Learning Disability vary based on the cutoff criterion used to define

Mathematics Learning Disability. Teisl, Mazzocco and Gwen (2001) analyzed how useful Kindergarten teacher ratings can be for predicting poor mathematics achievement in first grade. Challenges in identifying target skills for Mathematics Learning Disability screening and intervention are also addressed. (Mazzocco M. M., 2005).

Mazzocco and Myers (2003) discussed complexities in identifying and defining Mathematics Learning Disability in early elementary students; they explore the dynamic definitions that can be associated with Mathematics Learning Disability, and how these definitions vary depending on the measures used to identify children with Mathematics Learning Disability. The researchers (Mazzocco & Myers, 2003) stated that Mathematics Learning Disability occurs in approximately 6% of the population according to their literature review, which parallels statistics for Reading Disability (RD). Indeed, there are a large number of research studies dedicated to the area of Reading Disabilities, but very little for Mathematics Learning Disability by comparison; this parallels the imbalance between literacy and mathematics readiness research. Mazzocco and Myers (2003) referred to research that found some correlation between phonological processing and computational math skills, but also acknowledged that all children with RD do not have indicators for Mathematics Learning Disability, nor do all children with Mathematics Learning Disability have indicators for Reading Disability. Another confounding factor in attempting to define Mathematics Learning Disability is the determination of the specific math skills that are deemed important for assessment. Computational math skills are only a small contributor to knowledge necessary to experience success in mathematics:

Unlike the key basic processes that underlie reading achievement, mathematical achievement is cumulative throughout and beyond the elementary school years with quantitative and qualitative changes occurring within and across grade levels. The

required changes concern performance demands and the necessary prerequisite skills (Mazzocco & Myers, 2003, p. 220).

A single tool or a one-time assessment may misdiagnose some children as having Mathematics Learning Disability when no Mathematics Learning Disability is truly present, or some children as not having Mathematics Learning Disability when they do. Mazzocco and Myers (2003) believe this same caution should be applied when attempting to assess mathematics readiness. In addition to a math and reading skill battery, tests administered by Mazzocco and Myers (2003) included measures of memory, visuospatial and procedural subtypes of Mathematics Learning Disability. Mathematics Learning Disability occurrences in participants varied greatly depending on the criteria for Mathematics Learning Disability; further, occurrences of Mathematics Learning Disability varied over time for children. Nearly half (46%) of the participants met at least one of the Mathematics Learning Disability criteria in Kindergarten, and more than half (53%) met a single criterion at one point during the four-year longitudinal study (Mazzocco & Myers, 2003).

Predicting Mathematics Learning Disability from Kindergarten assessments

Mazzocco and Thompson (2005) attempted to predict Mathematics Learning Disability effectively in third grade from assessments administered in Kindergarten. The research involved the application of a battery of pre-existing tests to determine whether cognitive data collected in Kindergarten can effectively predict Mathematics Learning Disability in third grade, and whether abbreviated tests are as effective in predicting Mathematics Learning Disability as standard psycho-educational assessments. The abbreviated test items were further examined for correspondence to literature on Mathematics Learning Disability characteristics. By applying a regression model, individual test items were less predictive than using the standard scores. However, Mazzocco and Thompson (2005) found that models using a specific subset of test items dealing with reading numerals, number

constancy, magnitude judgements of one-digit numbers and mental addition or one-digit numbers were accurate in predicting Mathematics Learning Disability in third grade as the entire test battery administered in Kindergarten. This finding may be very beneficial because a standard mathematics assessment tool is perceived to be needed by Kindergarten teachers; specific test items have been found to predict Mathematics Learning Disability, the same types of items may lead to potential indicators for readiness.

Gender Issues with Mathematics Learning Disability

Lachance and Mazzocco (2006) refuted the hypothesis that there are gender differences in math and spatial skill in early elementary students. The study assessed possible gender differences in math achievement, and found that there was no statistically significant difference between elementary-aged boys and girls. The literature review acknowledged that other studies indicated a dominance of men in mathematics-oriented fields for employment, and that this gender imbalance may be due, in part, to a gender gap in mathematics achievement; the gender gap that is perceived of men outperforming women in mathematics achievement in adulthood appears to be disappearing generationally (Hyde, Fennema, & Lamon, 1990; Friedman, 1989). Lachance and Mazzocco's (2006) literature review is inconclusive and inconsistent in determining if this gender gap is perceived or real; and if a real imbalance, how the gap is influenced by inherent genetics or cultural socialization. While Lachance and Mazzocco (2006) acknowledge that studies have previously examined if a gender gap exists in early elementary school in their literature review, their study differed because it was longitudinal in nature. Other studies (i.e. Carr & Davis, 2001) found that when a gender difference in math achievement was measured, it was most pronounced in the highest or lowest achievement groups; that is, the average achievers showed very little evidence of a gender gap. In the high and low math achieving groups, studies from the literature review have found that boys outnumber girls (Swiatek, Lupkowski-Shoplik, & O'Donoghue, 2000; Reis & Park, 2001). Shorter studies have shown early elementary girls as slightly

above boys in general math achievement (Ginsberg & Russell, 1981), and elementary boys outperforming girls in specific math tasks (Lummis & Stevenson, 1990). The results of Lachance and Mazzocco's analysis (2006) did not indicate a persistent pattern of a gender gap for early elementary math achievement, nor for any one year of the study, nor any one area of math skill or spatial ability. There were as many statistically significant finding of girls outperforming boys as boys outperforming girls in math and spatial tasks, but not all within one area. With some confidence, this non-existent gender gap can be anticipated when considering mathematics readiness in Kindergarten children.

Implications of Mathematics Learning Disability Research for Mathematics Readiness

Research

Researchers (Mazzocco & Myers, 2003; Mazzocco & Thompson, 2005; Lachance & Mazzocco, 2006) found that while it seems evident that relying on a single indicator or test to predict or diagnose Mathematics Learning Disability is impractical due to its possible diagnostic ineffectiveness and certainly not reliable, this may happen in practice. While one indicator or a single test is unreliable, a small subset of test items can be found to be as effective as an entire battery of tests (Mazzocco & Thompson, 2005). The abbreviated test items could make diagnosing children at risk for Mathematics Learning Disability more efficient and precise. The difficulty in identifying children with Mathematics Learning Disability or who may be at risk for Mathematics Learning Disability is further complicated by the absence of consensus on the definition of Mathematics Learning Disability (Mazzocco M. M., 2005), though current research (Mazzocco & Myers, 2003; Mazzocco & Thompson, 2005; Lachance & Mazzocco, 2006) is attempting to be more strict with criteria for defining Mathematics Learning. Discriminating between children with low math achievement from those with average math achievement is troublesome, and may be an indication that the bottom threshold for low math achievement still needs refinement. Statistically, researchers estimate Mathematics Learning Disability to occur as frequently as RD and other LDs, in approximately 5% to 8% of school age children (Murphy,

Mazzocco, Hanich, & Early, 2007). It is currently recognized that there is still no true consensus on the clinical definition of Mathematics Learning Disability; these studies (Mazzocco & Myers, 2003; Mazzocco & Thompson, 2005; Lachance & Mazzocco, 2006) relied on an investigator-initiated definition of Mathematics Learning Disability. Specific cognitive characteristics of Mathematics Learning Disability included:

- Poor verbal short-term memory (numeric processing)
- Poor phonological memory
- Poor math fact retrieval skills

These same cognitive characteristics may have significant impact of Kindergarten students' readiness to learn mathematics.

Difficulty with math retrieval skills and calculations skills are reported regardless of co-occurring Reading Disability (RD). Mazzocco and Thompson (2005) cite Landerl et al. (2004) who speculated that cognitive characteristics of Mathematics Learning Disability are the same in children with or without co-occurring RD: poor numeric processing and math fact retrievals do not differ across Mathematics Learning Disability and RD groups of children. Therefore, relying on RD tests to determine MLD is not effective, nor would it be appropriate to rely on literacy readiness indicators for mathematics readiness in Kindergarten. Mazzocco and Thompson (2005) recognized that it is difficult to pull apart numerically 'pure' items from tasks that encompass academic performance in mathematics and reading (i.e. reading numerals). Rapid automatized naming and visual spatial reasoning correlated to concurrent and later math performance, but were not necessarily skills indicative of Mathematics Learning Disability.

From current research on Mathematics Learning Disabilities, mathematics readiness research can be informed. Indeed, determining indicators of a Mathematics Learning Disability can be complex (Mazzocco & Myers, 2003), and so one can reasonably anticipate complexity in identifying indicators of

mathematics readiness. Indicators for Mathematics Learning Disabilities in third grade could be predicted from Kindergarten assessments (Mazzocco & Thompson, 2005), which may indicate that given proper intervention from a mathematics readiness assessment, children who are experiencing difficulty could be provided with proper early intervention. Lachance and Mazzocco (2006) did not find any statistical gender differences in Mathematics Learning Disabilities, and this would lead to a logical assumption that perhaps this same gender balance can be found in mathematics readiness research.

Current Assessment Practices in Early Elementary Schools

Early elementary assessments for children pose particular challenges for the researcher and for practicing teachers. Assessment activities must be well designed, engaging, allow children to demonstrate knowledge in the specific domain being assessed, and the assessment must have sensitive diagnostic qualities (Rogers, 2007). The demonstration of the understanding of the concept is important, but the children must also understand the task requirements and the questions for the assessments to be valid and to evaluate the knowledge that is truly being sought (Rogers, 2004).

In Nova Scotia schools, and in particular the Halifax Regional School Board, there has been a movement towards data driven decision making for school improvement. During the 2003-2004 school year, the first annual Planning for Improvement (PFI) survey was administered, and data were collected from teachers, administrations, parents, staff, and students (Halifax Regional School Board, 2008). Originally, all students were surveyed, but with the inexperience of young students in completing forms for surveys, combined with the instructions given to teachers to not explain the questions or help with filling out the bubble sheet, survey data were skewed. As a result, only students in third grade and above are now asked to complete the survey. Data are also expected to support detailed student evaluations, such as report cards, and principals are looking for data to support their individual school's Planning for Improvement goals. As has been previously noted (Rogers, 2004), collecting data from very

young children does pose a challenge, since the process of filling out a survey or even completing a test must first be taught before the information in the assessment can be considered valid. As such, teachers of young children are responsible for very careful observation and maintenance of notes to produce the data to support the student achievement reports and results for early elementary students.

Current Kindergarten Mathematics Curriculum Outcomes.

As a Kindergarten teacher, when planning for instruction, I usually begin with the expected grade level outcomes and work backward (see Appendix A: NS Kindergarten Mathematics Curriculum Outcomes and Necessary Prior Knowledge). In Appendix A, I have created a column outlining prior knowledge, or concepts, that a child would need in order to achieve the corresponding Kindergarten mathematics outcome successfully. The current Mathematics Outcomes for Atlantic Canada (Nova Scotia Department of Education and Culture, 1998) was last updated ten years ago. The Department of Education is currently reviewing the prescribed curriculum outcomes for mathematics, and is expected to be consulting other provincial education departments, teachers and researchers. Current Kindergarten mathematics curriculum outcomes are important to reflect upon, because in this study, teachers were surveyed on how they assess mathematics readiness and assessing necessary prior knowledge is an anticipated technique.

Mathematics Assessments in Early Elementary.

Preschool teachers prefer to integrate mathematics into the everyday routines of a classroom (Lee & Ginsberg, 2007), which makes the mathematics meaningful and connected to the children's world. In particular, teachers of students in low socioeconomic situations in Lee and Ginsberg's study (2007) felt it was important to set aside time for mathematics, and favoured pre-made mathematics curriculum and manipulatives. Preschool teachers of students with middle-socioeconomic status tended to tailor their lessons to the students' interests, while the teachers of students with low-socioeconomic

status felt that academic- and content -centred instruction was most important. Preschool teachers of students with low-socioeconomic status worried about the students' readiness for school, while teachers of students with middle-socioeconomic status worried more about socialization. Preschool teachers of students with middle-socioeconomic status still provided literacy and mathematics rich environments, and allowed children more choice about the activities they wanted to engage in. These teachers also used informal assessments of literacy and mathematics to develop individually appropriate mathematics and literacy plans. Preschool teachers of students with low-socioeconomic status were more concerned about the students' literacy readiness than their mathematics readiness. Interestingly, there was a shift in how to teach literacy and mathematics: literacy was about promoting and instilling positive attitudes toward literacy, and participation in literacy activities were always a child's choice (though socialization continued to trump literacy instruction); mathematics was about promoting children's learning of mathematics content and skills, and noticeably not about promoting mathematics understanding. There is no mention of fostering enjoyment in mathematics, and mathematics was usually embedded in routines or explicitly taught, rather than being a choice for a child's activity. More time was spent on literacy than mathematics in a school day; literacy tended to be more heavily weighted in preservice teaching programs and in the professional development of practicing teachers than mathematics, which may account for this imbalance in instructional time and focus (Layzer, Goodson, & Moss, 1993).

Formal Mathematics Assessments.

KeyMath (Connolly, 1971, 1976, 1988, 1998, 2007) is a mathematics assessment designed for students ranging from Kindergarten through to grade nine. Publisher information (Connolly, 2007) indicates that teachers with a bachelor's degree and formal training in mathematics and coursework in measurement and interpretations of tests can administer *KeyMath* assessments. This generally excludes many classroom teachers; for example, in the Halifax Regional School Board, resource teachers and

school psychologists are the only professionals trained and permitted to administer this test. *KeyMath Revised* areas of focus are grade correspondence do not correlate perfectly to the National Council of Teachers of Mathematics (NCTM) or any Canadian mathematics outcomes (Shriner & Salvia, 1988) . KeyMath 3 (Connolly, 2007) is the newest KeyMath version, though the Canadian edition of KeyMath Revised (Connolly, 1988, 1998) is currently in use throughout the Halifax Regional Municipality.

PRIME (Small, 2004-2007), which stands for Professional Resources and Instruction for Mathematics Educators, is a resource designed to complement developmental stages of mathematics learning with “Developmental Maps” that indicate skills and concepts teachers will observe elementary students demonstrating at each stage. The resource is paired with a minimum 15 hours of professional development training for each Strand Kit. *PRIME* (Small, 2004-2007) is a costly programme that some school boards, like the Halifax Regional School Board, is promoting with professional development for all elementary and junior high resource teachers, and school-wide implementation of the program for select schools each academic year. Teachers who participate in the 15 hours of professional development are given a Strand Kit (the Halifax Regional School Board is beginning with distributing and training teachers with the “Numbers and Operations” Kit, though there is a Strand Kit for every mathematical strand). Within this Strand Kit are lesson ideas to move students from one developmental mathematics “stage” to the next, and “Diagnostic Tools” to determine a child’s developmental stage. The “Diagnostic Tools” are designed for one-on-one administration, and are a mixture of interview assessments (recommended by the publisher for grades Kindergarten to Grade 3) and written assessments (for students in Grade 3 and above). The “Diagnostic Tools” correspond to the program developers’ determination of the developmental stages, and not to the grade level expectations.

Assessment Tools for Other Curriculum Areas.

There exists a resource for early literacy assessments that Nova Scotia teachers use (Clay M. M., 1995). One component of Clay's survey is a "Running Record," an efficient, guided observation of student reading achievement. All early elementary teachers in the Halifax Regional School Board, for example, are expected to maintain monthly "Running Records" to monitor reading progress until students are fluent readers. "Running Records" monitor students' reading accuracy and fluency, and also provide categorization of errors and self-corrections, such as errors for meaning, syntax or visual cues (referred by Clay as Miscue Analysis). Results from "Running Records" and the Miscue Analysis inform teachers' instructional planning, since they can use reading strategies to address common errors, provide small group instruction, and do one-on-one coaching. Teachers are encouraged to create reading groups not only based on the "level" at which students are reading, but also for the strategies that need to be reinforced (determined from results of the Miscue Analysis) and for the topics of interest. For emergent readers, Clay's component of *An Observational Survey of Early Literacy Achievement* (1995), the "Concepts of Print," provides very clear results from a one-on-one interview that informs the teacher about pre-reading and early reading strategies the students have mastered or need to work on. Such pre-reading skills can include directionality of print, parts and order of a book, letters, and words.

Clay's concise and efficient literacy survey (1995) is widely used around the world (Ross, 2004). In Nova Scotia, in contrast, no similar classroom assessment exists for assessing or monitoring student readiness or achievement in mathematics, though some are developed and used in other areas of Canada (BC Ministry of Education, 2003a). A research-based mathematics readiness assessment tool for Kindergarten teachers' use is possible to develop. By surveying Kindergarten teachers on how they currently assess mathematics readiness, and contrasting this practice with that of literacy readiness, I

can determine that Kindergarten teachers would benefit from using a math readiness assessment, and particular features they would want to see in such an assessment.

Historical and Current Teacher Perceptions

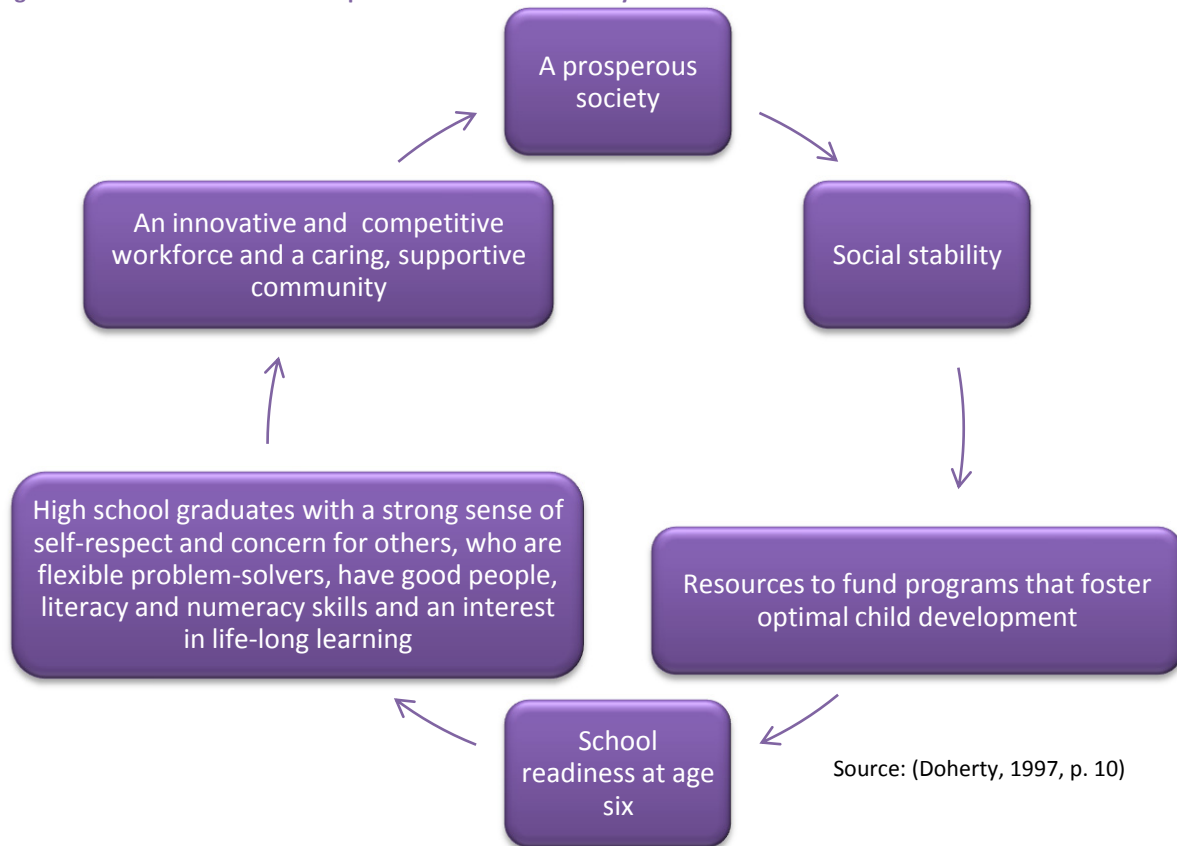
Teachers' Perceptions of School Readiness

In a 1993 study, the US Department of Education conducted a survey of Public School teachers to determine their views on children's readiness for school (Heaviside & Farris, 1993). It was reported that 96% of surveyed teachers believed that readiness for school was best indicated by factors such as physical health, appropriate rest, and proper nourishment. 84% believed that verbal communication, such as being able to communicate needs, wants, and thoughts, was important for school readiness. Maturity was believed to be a major influence on school readiness, and 88% believe that this is a trait that cannot be pushed ahead of the child's individual development; but 94% believe that a child's readiness can be enhanced with appropriate experiences.

In reviewing the data in the US Kindergarten teachers' survey on readiness report (Heaviside & Farris, 1993), data generated for math is clumped together with reading, while reading readiness is examined more carefully with follow-up questions. For example, a minority, (30%) of Kindergarten teachers believed that students who received formal math and reading instruction in preschool have little lasting effect; nonetheless, results from this study indicate that Kindergarten teachers believed that readiness can be enhanced with meaningful skill-building experiences. The only math questions pertained to the use of manipulatives, with about 50% of all teachers using manipulatives each day, and questions on the use of worksheets (results were 14% in math and science and 18% for literacy skills). However, looking at manipulatives and worksheet use in Kindergarten is not a very effective assessment of mathematics readiness (Heaviside & Farris, 1993).

In 1997, a Canadian review of school readiness was published by the government of Canada (Doherty, 1997). This report is interesting because of the underlying motivation for a government to study school readiness, which is its eventual impact on employment and tax contributions; see Figure 3: Canadian Interrelationship of Education and Economy (Doherty, 1997, p. 10). Nonetheless, important trends and information is contained within the report.

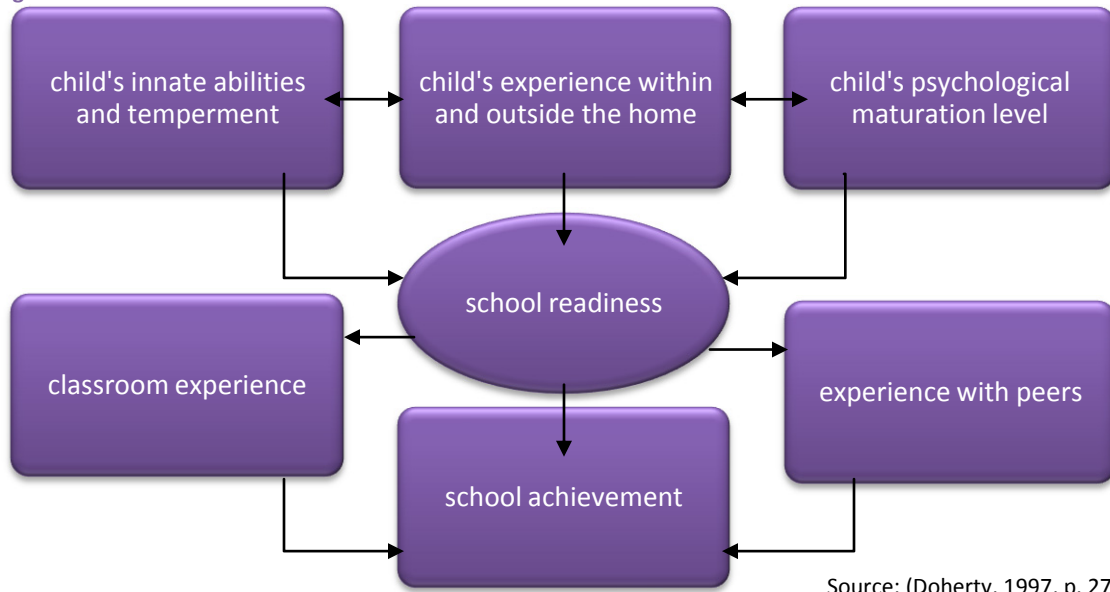
Figure 3: Canadian Interrelationship of Education and Economy



Doherty’s Canadian report echoed the US report (Heaviside & Farris, 1993), by placing an emphasis on physical well-being and appropriate motor development. Doherty (1997) proposed that this is because frequent illness in early elementary may influence a child’s attendance for formal school and ultimate knowledge acquisition. Underdeveloped motor skills may be a source for frustration and result in poor self-image for Kindergarten students. Emotional maturity is important for self-confidence in the learning process, so that when teaching beyond a child’s comfort level, the child will not

withdraw. Age-appropriate social knowledge and competence is also paramount. Doherty cited Feldhusen et al. (1970) and Lambert (1972) who indicated that disruptive behaviour in elementary school predicts poor grades in high school, even when IQ is taken into account. Language skills, general knowledge, and cognitive skills that are age appropriate are also important indicators for school readiness. The author included many math skills under the umbrella of general knowledge and cognitive skills, such as cause and effect, using representations for real objects, categorizing and sorting by one or more attributes. Young children's experiences during the first six years of life have a great impact of adult competence of knowledge bases and skills. Doherty (1997) adopted the Piagetan belief that each developmental stage is dependent on the preceding one. However, the interaction between a child's genetic endowment, physiological maturity and experience also were considered. Doherty's diagram of this interaction and its influence on school readiness is represented in Figure 4: Determinants of School Readiness and Later School Success (Doherty, 1997, p. 27).

Figure 4: Determinants of School Readiness and Later School Success



Mathematics Achievement and Success

While it seems that literacy is heavily favoured in comparison to mathematics for support of teachers’ professional development and student assessment for achievement and success, within mathematics there is an imbalance as well. Numbers and operations are often heavily relied on for indication of mathematics success. Numeracy and literacy are highly valued indicators of intelligence, but so should spatial intelligence (Deizmann & Watters, 2000) and problem solving skills (Rogers, 2004). Disproportionate teacher instruction on the symbolic and algorithmic aspect of learning mathematics skills exists:

Most teaching and assessment in mathematics takes place in the context of reading, writing and pictures. Teachers demonstrate the writing of numbers and other symbols, combine the two in written calculations, and children read and respond to written questions. What is not commonly recognised is that written numerals and signs are *secondary* representation in symbolic form. As such it is one step removed from the *primary* representation, which is the actual situation in which the (mathematical)

activity originally took place. As such, a learner's ability to understand the secondary (symbolic) representation rests upon his grasp of the primary representation to which it refers, the first-hand experience. For younger children, first-hand experiences involving number are concrete, observing everyday items being handled and moved, such as toys and food items (Rogers, 2007, p. 212).

Lee and Ginsberg (2007) found that preschool teachers' beliefs about the appropriateness of mathematics education varied depending on the socioeconomic status of the students. Teachers who taught children of middle socioeconomic status generally allowed student interest to guide instruction and focused on non-academic areas. Teachers of children with low socio-economic backgrounds were more concerned about the children's lack of readiness for school and focused on academic areas, with a particular focus on literacy.

Contemporary preservice teachers are entering education programs with more constructivist beliefs about mathematics education than preservice teachers in the late 1960s when the "new math" era was just beginning (Seaman, Szydlick, Szydlick, & Beam, 2005). This same study also found that through the education training programmes, preservice teachers increased constructivist-teaching practices, which were originally believed by the preservice teachers to require more traditional teaching methods.

When considering and collecting data on teachers' beliefs about their teaching practice, teachers often misrepresent their true practice by reporting what they think the researcher would want them to believe. For example, Charlesworth, Hart, Burts, Thomasson, Mosley, and Fleege (1993) found that teachers claimed to believe in the importance of developmentally appropriate teaching practices, but there was low correlation with the observed and collected data on classroom activities and materials. "Attention needs to be paid to the negative effects of incomprehension of a prominent part

of the mathematics curriculum in which young children are involved on a daily basis. It may be that such incomprehension prompts the early lack of confidence in mathematics that characterises further failure and poor problem-solving during the later school years, an issue highlighted by Rogers (2006)” (Rogers, 2007, p. 223).

In a separate study, researchers found that teachers’ beliefs corresponded to their practice in mathematics instruction, and that the level of teacher confidence in teaching mathematics was directly related to student self-confidence as mathematical learners (Stipek, Givvin, Salmon, & MacGyvers, 2001). Thus, it is possible to anticipate teachers’ surveys in this current study to be slightly more skewed than the reality, but nonetheless reflective of reality.

Mazzocco and colleagues (Teisl, Mazzocco, & Myers, 2001) evaluated the usefulness of teacher ratings in predicting low math achievement. Academic demands on young students continue to rise, and identifying those least likely to succeed academically early is important for early intervention. Diagnosing mild or moderate academic difficulties is more challenging than diagnosing severe academic difficulties, especially in young children, due to rapid and varied development in virtually every area for growth. Misdiagnoses of a Mathematics Learning Disability, or any other Learning Disability, could have a potential negative impact on a child and the child’s family. A child with a true Learning Disability could mistakenly be diagnosed as not having a Learning Disability, resulting in fewer or no supportive interventions for that child. Conversely, one could mistakenly misdiagnose a child with a Learning Disability when one is not present. Researchers (Teisl, Mazzocco, & Myers, 2001) cited Scanlon & Vellutino (1996) who believed that early identification of learning difficulties is possible. In research, batteries of tests and teacher assessments have been used as tools to predict, diagnose, identify or classify a Learning Disability. The methodology in diagnosing or predicting Mathematics Learning Disability is problematic because there is no consensus on what aspects of tests or rating scales predict

future low achievement. Batteries of tests typically look at cognitive, behavioural, social, and academic aptitudes of the student. Teacher assessments take the form of scales, ranking, grade equivalency and predictions on scores for a test or individual test items; some battery of tests may also include questions of this form, but teacher assessments typically rely on teacher instinct and perceptions of the student. Conclusions of the study (Teisl, Mazzocco, & Myers, 2001) were that teacher judgements correspond with academic achievement, though teachers seemed to inflate some students' ratings to avoid rating students below grade level. Perhaps this is due to the belief that all children can learn, and by projecting hope, poor predictions ensue; that is, the teachers were projecting with high expectations on the belief that the children would ultimately learn and understand the concepts. This belief in the students, even students who may not achieve, may lead to higher predictions because the teacher hopes that the children will meet the expectations. Kindergarten teachers identified 85.3% of students with math or reading difficulty in first grade with some concern in Kindergarten. Teachers were accurate in predicting students who would succeed. With the accuracy in predicting average and above average students, the recommendation is that perhaps individual screening would be beneficial for the teacher-identified below average students for possible LD (though, as has been stated, screening for Mathematics Learning Disability is not yet clearly defined due to lack of consensus on identifying criteria). This combination of standard tests with teacher observations for students most at risk of developing LD may be more efficient and more accurate.

Efficacy of Current Assessment Practices.

"Running Records" (Clay M. M., 1995), commonly used standard early literacy achievement assessments used in Nova Scotia, are considered reliable and effective, and teachers appreciate their efficiency. However, "Running Records" are best used frequently and with a variety of passages to secure a child's true reading achievement. Recommendations to use three similarly levelled, but different passages, and then to average the accuracy would produce a more accurate reflection on the

child's reading achievement (Fawson, Reutzel, Smith, Ludlow, & Sudweeks, 2006). It appears that schools with teachers who are actively using "Running Records" as a tool for assessment and planning for instruction have a positive impact on student achievement in reading and writing than those schools that use non-standard observation and anecdotal notes (Ross, 2004). According to this study (Ross, 2004), a support system for teachers was important to the resulting student success. Of course, "Running Records" is also part of a very costly intervention called *Reading Recovery* (Clay M. M., 1993). *Reading Recovery* is designed as an intensive reading intervention program for the bottom tenth percent of first grade students in reading achievement. In the Halifax Regional School Board, many schools have *Reading Recovery*-trained teachers at a great expense to the school board and work with a maximum of four students for approximately 16 to 20 weeks. Many of these students are successful in the program, but regression is also common once the daily half-hour interventions, and one-on-one instruction meetings, are terminated. Researchers question the cost effectiveness of this program since it only reaches a very small percentage of students (Groff, 2004). I also question whether the *Reading Recovery* (Clay M. M., 1993) program is the reason for student success, or whether it is the one-on-one half-hour of focussed and invested time the student at-risk spends with a literacy-interested adult. *Reading Recovery* is highly criticized due to the lack of empirical research in support of its development and methodology shortcomings (Center, Wheldall, & Freeman, 1992). Marie Clay's (1993) own evaluation of the program has been criticised (Nicholson, 1989). Critics of *Reading Recovery* believe that phonological awareness is a vital component lacking direct instruction in the program (Iverson & Tunmer, 1993; Center Y. , Wheldall, Freeman, Outhred, & McNaught, 1995). "Running Records" is a component of *Reading Recovery* that has been isolated, and is available at little cost to any early elementary teacher interested in using the instrument.

KeyMath Revised (Connoly, 1971, 1976, 1988, 1998, 2007) was normed in 1985 and 1986 with a sample of 1798 students; though clear and concise norms for *KeyMath Revised* are not appropriate at all

grade levels due to small samples, and the sub-tests have low reliability to pinpoint Mathematics Disabilities (Perez, 1996). *KeyMath 3* is still designed for individual assessments, and is now enhanced with NCTM corresponding lessons (though there is no publisher indication as to whether or not the test itself is more connected to the NCTM outcomes). Pre- and post-assessments are available to assess students' understanding of the prerequisite skills before the lessons on mathematical concepts and to assess students' understanding of the new skills and concepts introduced in the lesson(s). Children from the age of four years and six months to 21 years are potential examinees, and norms are provided for age and grade designation. *KeyMath* is not a viable mathematics readiness assessment tool due to its limitations of the kinds of professionals who can administer the assessment, the poor correlation of the test to NCTM standards, and low reliability of the sub-tests; which is particularly relevant to lower grades. Nova Scotia, and, indeed, most Canadian education departments, currently base the mathematics curriculum and grade level outcomes on NCTM standards.

PRIME (Small, 2004-2007) math materials are the product of a research-initiative, and seem to have been created in response to the lack of task-based assessments and to support teachers in their use of mathematics instruction with the use of manipulatives. Largely, *PRIME* (Small, 2004-2007) is a professional resource, and not a standardized assessment. The Developmental Maps (intended by the publisher to "identify and confirm") organize "skills" and "concepts" separately, which I find troublesome. I believe that teachers can unknowingly become transmitters of knowledge when students are encouraged to have concepts emerge from skills; I believe that students take a more active and meaningful role in learning mathematics concepts when activities are designed for students to "discover" the mathematics concepts and hone the skills in due time. The "Diagnostic Tools" are not truly diagnostic in nature, and facilitators to the *PRIME* (Small, 2004-2007) professional development training emphasize that the tests are for informational purposes. Nonetheless, publisher information describes the "Diagnostic Tools Booklets" to diagnose and support; the word "Diagnostic" appears at the

top of every test document, and the intention of the tool may surely be misinterpreted and misapplied to diagnose students and for programming decisions. The “Background and Strategies” booklet is designed to help teachers choose lessons to move children from one stage on the “Developmental Map” to the next by applying strategy. Results of the “diagnostic Tools” are not normed, and test items are repeated throughout the publisher-determined developmental stages of the “Diagnostic Tools.” Publishers do not recommend using *PRIME* (Small, 2004-2007) assessments with Kindergarten students prior to the final term of the academic year, and as such is not a readiness assessment. The “Diagnostic Tool” items are stages do not follow the grade level curriculum expectations, but the product-developer’s determination of the mathematics developmental stages.

Conclusion to the Chapter

This chapter has reviewed research relevant to the broad field of school readiness, and the specific fields of mathematics readiness and assessment, and current assessment practices in elementary schools.

Research studies indicate that developmental and other factors can impact school readiness (Cahan & Cohen, 1989; Clifford, Bryant, & Early, 2005; Coates, 2004; Crosser, 1991; Datar, 2006; Diamond, Regan, & Bandyk, 2000; Doherty, 1997; Government of Nova Scotia: Department of Education, 2008; Gredler, 1992; Kinard & Reinherz, 1986; Layzer, Goodson, & Moss, 1993; Lincove & Painter, 2006; Lummis & Stevenson, 1990; Oshima & Domaleski, 2006; Spitzer, Cupp, & Parke, 1995; Stipek, School entry age, 2003; Weast, 2001; West, Meek, & Hurst, 2000). Canadian studies found that the single most influential indicator for readiness is parental concern and involvement (Coates, 2004; Thomas, 2006). Age or the birth date cutoff criterion for Kindergarten enrolment eligibility, while a highly contested topic of discussion in light of readiness and academic achievement by government policy makers (Government of Nova Scotia: Department of Education, 2008; Government of Prince

Edward Island, 2008; Canadian Broadcasting Corporation, 2007; Early Childhood Learning Agency, 2008) and researchers (Cahan & Cohen, 1989; Crosser, 1991; Datar, 2006; Kinard & Reinherz, 1986; Lincove & Painter, 2006; Spitzer, Cupp, & Parke, 1995; Stipek, 2003; West, Meek, & Hurst, 2000), is an unreliable indicator for school readiness and academic achievement.

Mathematics readiness research is usually included in school readiness studies as a small component including exclusively numeracy readiness (Heaviside & Farris, 1993; Doherty, 1997; Human Resources and Social Development Canada, 2007b; 2007a). *KeyMath* (Connoly, 1971, 1976, 1988, 1998, 2007) is a mathematics assessment tool for early elementary students (and up to ninth grade) available around the world, though Halifax Regional School Board classroom teachers, for example, are not qualified to administer the instrument without specific training that is usually limited to Resource teachers (Halifax Regional School Board, 2006); critics comment that the instrument has low reliability (Perez, 1996) nor does it correlate to the NCTM standards that our curriculum is based upon (Shriner & Salvia, 1988). *PRIME* (Small, 2004-2007) materials are available to teachers who have participated in the required professional development training that accompanies the resource; the *PRIME* Diagnostic Tools correspond to the publisher-determined developmental stages, and while it is a research-initiative resource, other research is not cited as supporting the development of the product, nor are results of the Diagnostic Tools normed. When considering teaching and monitoring of student achievement in mathematics, there are several influential thinkers on the topic that influence a teacher's approach to facilitating mathematics understanding for students: Piaget, Gardner, Dienes, the Van Heiles, and Vygotsky have similar but different approaches to describing the acquisition of mathematics understanding. Piaget promotes developmental stages (Piaget, 1972; 1952), Gardner proposes that individuals have Multiple Intelligences (Gardner, 1983; 1999; 2006; Harvard Graduate School of Education, 2000), Dienes believes in constructivism (Dienes, 2008; 2003; Sriraman & Lesh, 2007), the Van Heiles have developed a hierarchical sequence of necessary steps to achieving higher level

geometric thinking (Van Hiele, 1986), and Vygotsky's contribution to learning has been the Zone of Proximal Development (Vygotsky, 1978) which means teaching the child in challenging, but not frustrating, ways for achievement. While these influential thinkers on mathematics have broad approaches to mathematics, as it has already been stated, mathematics is often limited in school achievement and readiness research to exclusively numeracy. Early number concepts are well-researched (Box & Scott, 2004; Sarnecka & Gelman, 2004; Wynn, 1992; Sarnecka, Kamenskaya, Yamana, Ogura, & Yudovina, 2007; Sfard & Lavie, 2005; Zhou, Wang, Wang, & Wang, 2006; Lipton & Spelke, 2006; Rogers, 2007). Like school readiness, numeracy proficiency is not related to age, but to rich mathematics experiences, a broad and balanced curriculum, and meaningful problem solving experiences (Carol & Ray, 2003; Burns, 2000).

Current Kindergarten mathematics curriculum outcomes (Nova Scotia Department of Education and Culture, 1998) are achievable for many students, but the outcomes do require prerequisite skills that a Kindergarten teacher must assess for the outcomes to be met. Mathematics research in the area of readiness is minimal, but there is an emerging area of research on Mathematics Learning Disabilities that provides context for assessing readiness (Mazzocco M. M., 2005; Mazzocco & Myers, 2003; Mazzocco & Thompson, 2005; Murphy, Mazzocco, Hanich, & Early, 2007). By understanding early indicators of Mathematics Learning Disabilities, indicators necessary for mathematics learning can also be deduced. While there is no teacher-accessible mathematics assessment tool for readiness or early mathematics achievement in the Halifax area, Marie Clay's literacy assessment (Clay M. M., 1995) is available to classroom teachers, and her literacy intervention programme (Clay M. M., 1993) is available to trained *Reading Recovery* teachers in Canada and around the world (Ross, 2004), despite poor or little empirical research support (Fawson, Reutzel, Smith, Ludlow, & Sudweeks, 2006; Ross, 2004; Center, Wheldall, & Freeman, 1992; Nicholson, 1989; Iverson & Tunmer, 1993).

This chapter has also provided a theoretical framework for this thesis by reviewing research on historical and current teacher perceptions of school readiness (Heaviside & Farris, 1993), mathematics readiness (Deizmann & Watters, 2000; Rogers, 2004; Lee & Ginsberg, 2007; Seaman, Szydlick, Szydlick, & Beam, 2005; Charlesworth, Hart, Burts, Thomasson, Mosley, & Fleege, 1993; Stipek, School entry age, 2003) and achievement and the efficacy of current practices. While teachers' perceptions of student achievement can be slightly hopeful (Charlesworth, Hart, Burts, Thomasson, Mosley, & Fleege, 1993), teacher perceptions are generally accurate and reliable.

In the next chapter, I describe the methodology behind this study. An online teacher survey generated data necessary to contrast statistically teacher perceptions and beliefs around literacy and mathematics readiness. Chapter 3 explains my choices for participant recruitment, instrument development, the integration of quantitative and qualitative methods, and plans for descriptive data analysis.

Chapter 3: Methodology

Introduction to the Chapter

In the second chapter, I reviewed research on school readiness, mathematics readiness and achievement, current assessment practices in elementary schools, along with historical and current teacher perceptions on these three areas to inform the direction of this study and to provide a support for development of the online teacher survey on Kindergarten readiness. This chapter describes the methodology I followed in collecting data from teachers about their knowledge of incoming students' mathematics readiness. In this chapter, I outline the research design and instrument development for this study. I describe the participants this study required and explain the sampling technique to obtain a viable sample. I describe details on data collection and the plan to analyse the results with descriptive statistics.

Research in Mathematics Education

While mathematics is a field that has existed for centuries, if not millennia, and education has been a field for as long as knowledge has existed and people have shared knowledge, “mathematics education” research is new:

Mathematics education is congruent with neither mathematics nor education.

Mathematics education is an emerging discipline, no longer in infancy yet not fully adult.

We are in the formative adolescent years when it behoves us to seek to establish our identity as a legitimate, independent, academic community. To do this we must, among other tasks, address the notions of “research” and “methods” as they apply to the field within which we work. It is time for us to put aside the debate that tries to uphold or refute the supremacy of quantitative over qualitative methods. Neither has merit *in*

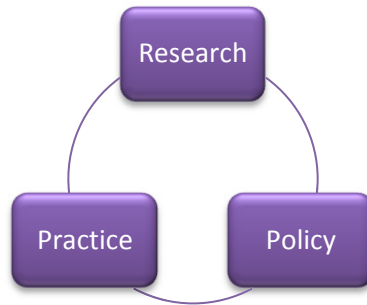
itself. The appropriateness of methods and methodologies espoused by researchers can be considered only in the light of the intentions of the specific research being undertaken (Pirie, 1998).

Pirie (1998) continues to say that mathematics education, a research field wanting to be independent and respected, requires mathematics education researchers to consider appropriate areas for inquiry. As the field itself settles into a more mature and stable state, so do areas for research within the field. Otherwise, research in mathematics education will “continue to be judged by the criteria for other disciplines” (Pirie, 1998), and therein lies the unjustified opinion that the scientific quantitative method of conducting research is more correct than a research-based qualitative approach. Research does not stem from the method, but the content, and indeed the research question. The research method is a vehicle to obtain answers to the research question. If the method is inconsistent with the question, then legitimate concerns about research results can arise from critics.

Educational research, and in particular mathematics educational research, is only going to have impact on student learning if practicing teachers can access it; research needs to help develop meaningful curricula beyond simply making improvements, and to make the learning of mathematics for understanding innovative (Teppo, 1998). All too often, educational decisions are made based on short (4-year term) political timelines. This short-term planning results in “band-aid” solutions for teaching and learning challenges, particularly in mathematics at the elementary level. Politicians, policy makers, school departments, and teachers need to collaborate and consult with researchers in relevant areas, and the research must make its way back to the classroom efficiently with the support of these politicians, policy makers, school departments and teachers (see Figure 5: The Cycle of Educational Research). Otherwise, no valuable research results and solutions can be implemented. Research is not

only a means to find solutions for classrooms, but also a means for the realities of the classrooms to provide solutions for researchers and policy makers (Teppo, 1998).

Figure 5: The Cycle of Educational Research



Research Design

My research questions aimed to collect information on types of effective mathematics readiness assessments strategies Kindergarten teachers use, and to study the individual perceptions of preparedness of Kindergarten teachers to teach and assess Mathematics in contrast to literacy. These two areas of focus allowed me to judge whether there is a need to develop a standard Mathematics readiness assessment tool. To collect data to answer my research questions and to interpret the results, I chose to design and administer a quantitative and qualitative online survey to elementary teachers. Participants were elementary teachers enrolled in graduate programmes in Nova Scotia, and I asked all participants to indicate the lowest grade taught. Given that there is so much movement among teaching positions in Nova Scotia, it was likely to obtain more participants who have taught Kindergarten in the past, if not currently. An online survey was a practical instrument to collect the desired data since completion of the survey was voluntary, done at a time convenient for the participants, and generated quantitative and qualitative data for analysis. A survey was especially effective for this study: it would have been rather impractical to observe many teachers assessing readiness in Kindergarten students in

the busy month of September. Research using a survey to collect data can ask the questions on the desired topic at any time (Gravetter & Forzano, 2006).

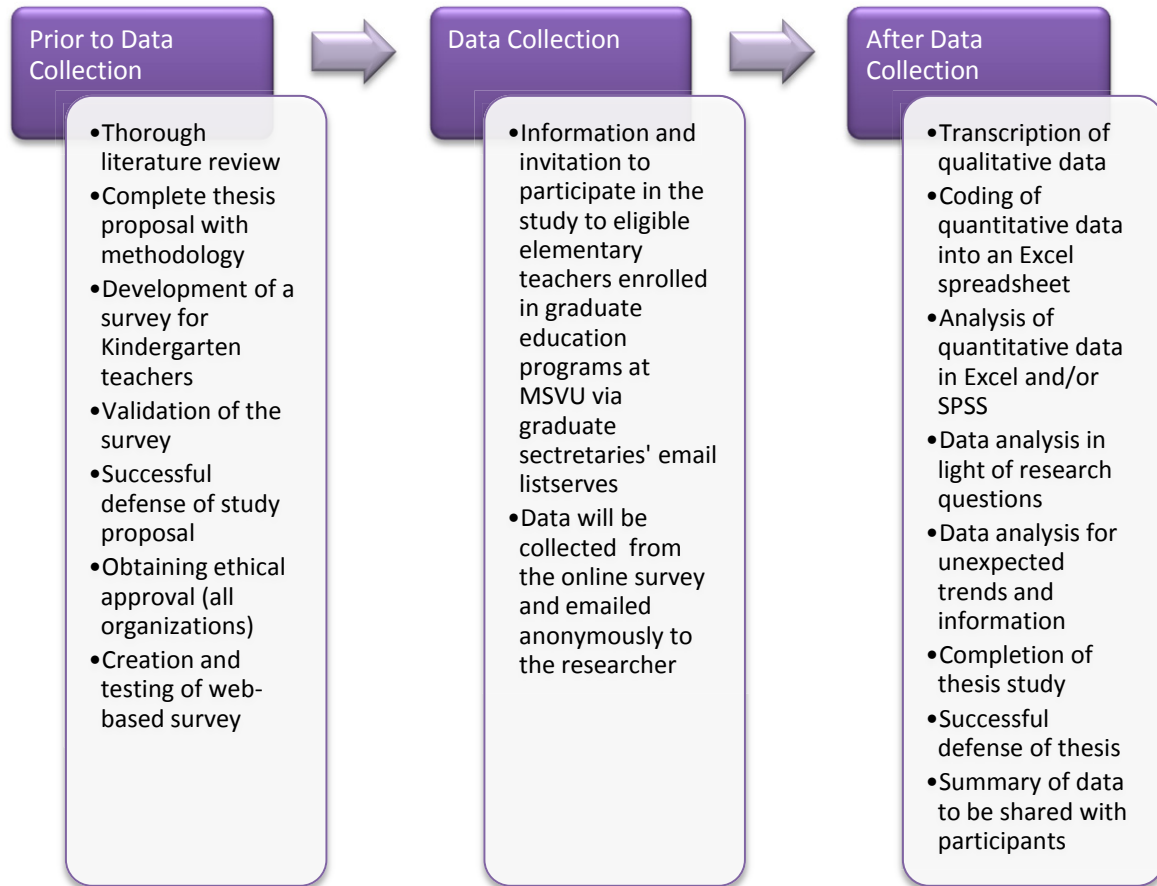
Researchers must examine both quantitative and qualitative research methods and must decide to use one, the other, or both in some combination. While the choice may be personal, it has implications for the acceptability of the results of the study (Pirie, 1998). The choice to use one research method, when the other method (or combination of both) would have been more appropriate, can leave the readers and critics of the educational research with serious doubts and questions. The researcher's early choice of methods can influence his or her reputation for accountability.

I chose to integrate both quantitative and qualitative research methods to answer my research questions: what teachers currently use to assess readiness in mathematics, and the teachers' level of preparedness for teaching mathematics. This combination of quantitative and qualitative research methods was appropriate for this study because it collected information on *what* and *how* teachers assess literacy and mathematics readiness. Quantitative research lends itself easily to statistical analysis, since it describes phenomena in numbers; qualitative research, on the other hand, describes phenomena in words. Researchers choosing to use qualitative research as a complementary or primary focus of mathematical education research can ensure some perspective and interest from the results of the research. Qualitative results have a "human" quality that invites the reader into the research in a more relatable way; qualitative approaches can also provide practical information for improvements, observations and critiques of the educational practice in schools today (Teppo, 1998). Educational research now accepts qualitative research as a form of legitimate research, and often (particularly in early educational research) the two divergent methods are mixed. I am not only interested in *what* (quantitatively) the teachers perceive to be student readiness or what the teachers are teaching, but *how* (qualitatively) teachers assess student readiness. Both methods have been accepted and are

different and important ways to focus educational research (Teppo, 1998). Both quantitative and qualitative approaches were necessary for this study since they provided different information to learn of teachers’ perceptions of students’ readiness.

To prepare for this study, I devised a research strategy (See Figure 6: Research Strategy) that has been revised throughout the process of design. The online survey was at the heart of this study, and the detailed steps prior to and after data collection are important for the meaningfulness and effectiveness of my research.

Figure 6: Research Strategy



Instrument Development

The online teacher survey generated quantitative and qualitative data necessary for this study (see Appendix L: Readiness and Assessment in Early Elementary Survey). A survey was the best method for evaluating the design and efficacy of current mathematics readiness assessments. Participants remained anonymous and participants completed the survey at a convenient time. Other graduate students (Murray, 2007; Gillis, 2007) have collected data using surveys, though not on this topic, nor as an online study.

Participating graduate education students in Nova Scotia, who are also elementary teachers, completed the online survey, which was both quantitative and qualitative in nature. I compared data on teachers' perceptions of mathematics readiness and assessment practice to data on literacy readiness and assessment practices from online survey questions for data analysis. There was no indication that the results of the study would be to examine mathematics readiness in particular to prevent any bias in completing the survey. The purpose of this study was to situate teachers' perceptions of mathematics readiness of Kindergarten students with literacy readiness.

The survey asked teachers to reflect on their perceptions of student readiness, and perceptions of support from the school administration, the school board, and the provincial education department in the academic areas of literacy and mathematics. I asked teachers to report on the informal or formal assessments they use to assess such readiness, as well as achievement assessments for the remainder of the school year. Likert-type scales generated quantitative data necessary for analysing the results of this study, and text boxes generated qualitative data on the kinds of informal teacher-created assessments used. To avoid the tendency participants may have to select the same descriptor for every question, a mixture of positive and negative questions was used (Gravetter & Forzano, 2006), particularly with

questions focused on comparing beliefs and experiences with literacy and mathematics instruction and readiness.

The survey was a short series of web pages. The first web page of the online participants' survey had the directions for completion clearly outlined, and a button for participants to click on to indicate consent (see Appendix K: Participants' Package- Introduction Webpage with Informed Consent, Figure 38: Elementary Readiness Survey- Informed Consent as Seen Online). The second webpage contained the survey itself (see Figure 39: Readiness and Assessment in Elementary Survey for Elementary Teachers as Seen Online), and the last webpage was a thank you message (see Figure 40: Thank You Page as Seen Online) with an optional comments section; both WebPages can be seen in Appendix L: Readiness and Assessment in Early Elementary Survey for Kindergarten Teachers. All web pages were simple and uncluttered. Following Canadian guidelines for the development of online surveys, I carefully considered and ordered the questions (Lumsden, 2005). There were a small number of questions in the survey to minimize abandonment of the online survey. Recommendations for short sentences (no more than 20 words), written in the present tense and active voice were followed in the development of this instrument. The first question (pertaining to how children learn best and regularly used teaching methods) was engaging and easy to answer; research shows that this will "hook" the participant to complete the remainder of the survey (Lumsden, 2005). The most important questions pertaining to mathematics readiness assessment techniques and beliefs appeared about one third of the way into the survey. Lumsden (2005) indicates that this ensures the participant is settled into the survey, but not bored. Important questions (such as assessment techniques) were repeated, slightly reworded, at different points in the survey to ensure consistency in responses. In light of the qualitative questions requiring short, open-ended responses, Lumsden (2005) suggests placing them approximately two-thirds of the way into the survey for appropriate variation in question style and to maintain the participants' interests. Open-ended questions also appeared before questions on the same topic that

are close-ended (i.e. select response questions) to minimize influencing the participants. No graphics were required for this online survey, and this was beneficial because some download times of low-speed Internet connections could have contributed to abandonment.

Participants and Sampling Technique

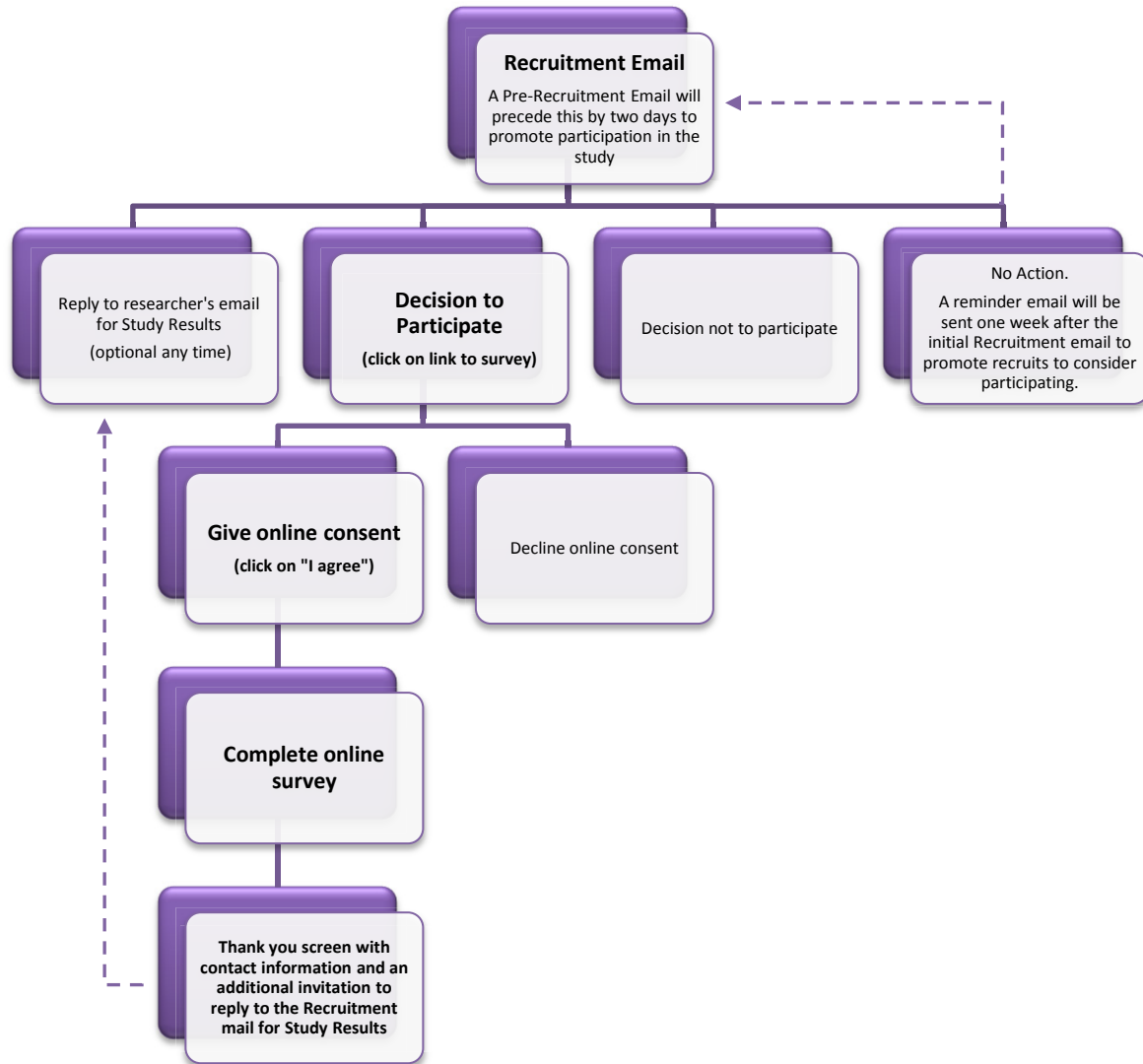
While I initially planned to survey only current Kindergarten teachers, I changed my target participant recruitment population to all elementary teachers. Securing access to Kindergarten teachers via school boards proved to be very challenging, since many school boards collect data from their teachers regularly, and discourage external researchers from conducting their own studies. By recruiting participants through graduate programmes in Nova Scotia, I was able to secure an appropriate sample because many teachers may have taught Kindergarten in the past. The participant sample for this project included elementary and Kindergarten teachers who are currently enrolled in graduate education programmes. Following ethical approval, I recruited participants by university email via graduate programme secretaries. This ensured complete anonymity because I did not have access to any email addresses. I anticipated a minimum sample of 20 to 30 teachers to participate in the study, and received 84 responses to my request for participation in the study.

Procedure for Data Collection

I conducted this study during the school year once the study received ethics approval at the university. I arranged to have participants invited to participate and delivered the link to the online survey via university email. Figure 7: Participants' Decision Tree for Completion of the Online Study illustrates the series of steps participants engaged in to participating in this study. To increase return rates, a Pre-Recruitment Email was sent one day prior to the Recruitment Email to give participants advanced notice of the survey, and to outline their selection as a possible participant (see Appendix H: Participants' Package- Pre-Recruitment Email). A detailed Recruitment Email explained the topic and

emphasized the importance of each individual participant (see Appendix I: Participants' Package- Recruitment Email). The Recruitment Email contained a link to the online teacher survey and an invitation to email to the researcher to request research results upon completion of the study.

Figure 7: Participants' Decision Tree for Completion of the Online Study



Contact information regarding the researcher and supervisor for the study were presented in the Recruitment Email, on the Informed Consent Page, and on the Thank You page to the online survey.

Research (Gravetter & Forzano, 2006) recommends sending a reminder invitation to participants. One

week after the Recruitment Email had been sent, a Follow-Up Email reminder was sent to participants to encourage completion and prompt completion of the surveys (see Appendix J: Participants' Package-Follow-Up Email). I gave careful consideration to create an instrument that would minimize potential participants declining to complete the survey.

The Recruitment Email was very important to recruiting participants in this study: it outlined the study and provided a convincing pitch to have participants agree to complete the online survey. The Recruitment Email also had an invitation to request Research Results by emailing to the researcher. This ensured that no participants' identifying information (i.e. name or email address) was submitted along with the survey itself. The webmaster designed the online survey so the webmaster's automatic email system would direct results to the researcher's email inbox; no identifying information from participants was necessary for this information delivery.

The Ethical Informed Online Consent Form for participating teachers was on the introductory web page on the survey link (see Appendix K: Participants' Package- Introduction Webpage with Informed Consent). There was a button to click to indicate informed consent, and to proceed to the survey. Varnhagen and colleagues (2005) indicate that online informed consent is no different from paper presentation of the same information. O'Neill, Penrod and Bornstein (2003) found that requiring participants to do more than clicking of informed consent (i.e. entering a password or answering a question) deterred potential participants from participating. There are novel ways to entice participants to complete the survey and give online informed consent at <http://www.psych.ualberta.ca/~varn/ConsentStudy/> (Varnhagen, et al., 2005). This tactic was not possible for this study due to time restraints and professional commitments of the webmaster designing the survey; however, the informed consent that appeared online was concise and clear to promote participation.

Repeat responders or non-serious responders were not anticipated to be problems in this study; repeat responders are not found to be detrimental to online surveys, and results from online questionnaires are consistent with findings in paper surveys (Gosling, Vazire, Srivastava, & John, 2004).

Data Analysis

Data from the online teacher surveys were analysed with descriptive statistics; return rates and complete results from the survey are reported in Chapter 4. All quantitative data from the online survey was compiled in Excel. Likert-type scales generated quantitative information; percentages of respondents endorsing each statement were calculated. This uncovered current planning and teaching behaviour for assessing mathematics and literacy readiness, and indicated areas that may be better supported. Quantitative data from the survey was analyzed for perceived efficacy and attitudes with descriptive statistics. Responses to survey items on literacy readiness provided a context to analyse and interpret the mathematics readiness items. Qualitative responses were transcribed, analysed, and grouped to identify themes and patterns among and between respondents; summaries of relevant qualitative results are reported to compliment and provide context for the results of the quantitative data.

Conclusion to the Chapter

The purpose of this chapter was to explain and defend my choice for using an online survey to answer my research questions and to interpret the results. Mathematics education research is a relatively young area of research (Pirie, 1998), and as such, methods in mathematics education is not limited to mathematics research nor education research, but a blend of both. The cycle of educational research includes research, policy and practice (Teppo, 1998). At times, research will influence policy and in turn practice, while at other times, the cycle may be reversed. For this thesis, my experience with current policy in Nova Scotia and my own teaching practice lead me to develop this research study.

The research design for this study was rooted in quantitative and qualitative approaches. The online survey generated information and data to analyse statistically perceptions and beliefs regarding mathematics readiness, with literacy readiness used for comparison. From the results and analysis of the survey items, I can determine whether teachers are prepared for and specifically supported in the area of mathematics readiness.

The instrument development was rooted in online survey and questionnaire development research (O'Neill, Penrod, & Bornstein, 2003; Varnhagen, et al., 2005; Gosling, Vazire, Srivastava, & John, 2004; Lumsden, 2005). Online surveys are just as accurate in collecting data as traditional paper surveys (Varnhagen, et al., 2005). Issues of informed consent were addressed in this chapter (Varnhagen, et al., 2005), and are in line with NRC guidelines (Lumsden, 2005). An online survey was a practical instrument to recruit as many elementary teachers as possible. Potential participants were prepared for the invitation to participate in the research study with a Pre-Recruitment email. Participants were recruited with an engaging Recruitment Email, which minimized participants declining to participate (Lumsden, 2005); a reminder email was sent one week following the initial Recruitment Email. Effort was made to make this survey brief and interesting to recruit as many potential participants as possible. All participants were given to option to request results from the study.

The fourth chapter of this thesis reports the results of the study. Perceptions and beliefs on literacy readiness provide a context for comparison and conclusions around mathematics readiness through descriptive statistics and trends from qualitative results. Each section of the survey was analyzed in detail with supporting tables and charts; literacy results provide important context for interpreting the mathematics results. I address the research questions to determine whether there is a perceived imbalance in preparedness and specific support for assessing mathematics readiness.

Chapter 4: Results of the Study

Introduction to the Chapter

The purpose of surveying Kindergarten teachers was to determine how individual teachers currently assess their students' mathematics readiness, and whether teachers require support for the assessment of mathematics readiness. My goal was to interpret the results of this study to determine whether there is a perceived need for a common assessment tool for mathematics readiness. This study fills a significant void in the teaching of mathematics for understanding. Without the ability to assess mathematics readiness effectively and efficiently, a teacher cannot determine incoming Kindergarten students' mathematical knowledge; they cannot quickly determine the most beneficial way to move them forward in achieving the specific curriculum outcomes for that grade level. Instructional planning based on meeting the children where they are in their understanding of mathematics results in the students *meeting* the outcomes, not merely *covering* the topics involved in the outcomes.

The survey collected information on two areas of school readiness: literacy and mathematics; this was to provide a context for comparing teachers' perceptions of mathematics readiness to another dominant curriculum area. The purpose of the survey was to determine effective mathematics readiness assessment strategies that Kindergarten teachers use. The study also determines whether Kindergarten teachers' preparedness and willingness to assess mathematics readiness are significantly different from their preparedness and willingness to assess literacy readiness.

This chapter provides an overview of results obtained from the online readiness survey. Results are categorized according to the sections of the survey itself: grade level teaching assignments (current and lowest grade taught), beliefs about teaching and learning, beliefs and practice regarding mathematics and literacy, readiness of students for learning mathematics and literacy, assessment practices, preparedness for assessing literacy and mathematics readiness, and support from school

agencies in the area of readiness. Descriptive statistics was used to interpret the quantitative data, and when appropriate I have included trends from qualitative responses.

Analysis of the Results

Participants consisted of teachers who are currently registered in graduate education programmes in Nova Scotia. Eighty-four surveys were submitted in a ten-day period in late March and early April 2009. Of the 84 surveys, two were discarded because they were incomplete; 82 graduate student/teacher participants are included in results of this study. Survey responses were anonymously sent to the researcher's email from the website via the webmaster automatic email system.

Quantitative data was entered into an Excel database for analysis, and qualitative data was entered into a word processor. Each participant was given a Participant Number (in numerical order from 1-84) and an ID Code that corresponds to the month, day and time the email from the webmaster was received (i.e. 3241000 for March 24 at 10:00 am) in order to facilitate accuracy checks.

Introductory Information

Participants responded to two introductory questions regarding the current grade level taught and the lowest grade level ever taught (see Figure 8: Introduction Questions as Seen Online).

Figure 8: Introduction Questions as Seen Online

The screenshot shows a web interface for a survey. On the left, there is a vertical blue bar with the text 'Education Directory'. The main content area has a blue header with a circular logo containing a stylized 'E' and the text 'Readiness and Assessment in Elementary Survey for Elementary Teachers'. Below the header is a blue bar with the word 'Introduction' in white. The survey questions are listed below:

1. What elementary grade level do you currently teach?
 Other
2. What is the LOWEST elementary grade level you have taught?

Teachers of elementary classrooms were categorized according to the grade level taught, with numbers 0 to 6, where 0 indicates Kindergarten. For data analysis purposes, any teacher who indicated

a combined class (more than one grade), was categorized by the lowest grade, since I am most interested in early readiness. For example, a participant who indicated that the current grade taught is a “Grade 1/2” combined class, was coded as “Grade 1.” Participants who reported teaching in non-elementary-classroom-based positions were categorized as follows:

- Code 7 = Resource Teachers
- Code 8 = Literacy Specialists, including Reading Recover Teachers, Literacy Coordinator and Literacy Coaches
- Code 9 = Other Specialists, including Severe Learning Disability Teachers, Special Education Teachers, Literacy Centre Teachers
- Code 10 = Junior High teachers (who have taught an elementary grade as the lowest grade taught)

No participant indicated any specialization in Mathematics. The frequency table for grades taught for all participants indicates that almost half (46%) of participants reported Kindergarten as the lowest grade taught; in fact, 7 participants are currently teaching Kindergarten, which accounts for nearly 10% of all participants (see Table 2: Breakdown of Participants’ Current and Lowest Grades Taught).

Table 2: Breakdown of Participants’ Current and Lowest Grades Taught

Grade Taught:	Current	Lowest
Kindergarten/Primary (NS)	7	37
Grade 1	12	20
Grade 2	10	9
Grade 3	7	5
Grade 4	6	5
Grade 5	4	3
Grade 6	7	3
Resource	6	NA
Literacy Specialist	9	NA
Other Specialist	7	NA
Junior High	7	NA
TOTAL	82	82

When examining the 37 participants who indicated that the lowest grade taught was Kindergarten, the most frequently reported current grade taught was also Kindergarten (see Table 3: Current Teaching Assignments of Participants Who Indicated Kindergarten as the Lowest Grade Taught). Participants who reported their lowest grade taught was Kindergarten were currently teaching a variety of grade levels in a variety of positions. Six participants were teaching upper elementary (grades 4-6) and eleven were specialists in schools, such as Reading Recovery, Resource, Learning Centre teachers, Literacy Coaches, or Severe Learning Disability Specialists. More than half of these teachers (51%) were currently teaching in lower elementary (Grades K-3) classrooms.

Table 3: Current Teaching Assignments of Participants Who Indicated Kindergarten as the Lowest Grade Taught

Currently Teaching:	# Participants
Kindergarten (Primary)	7
Grade 1	5
Grade 2	4
Grade 3	3
Grade 4	1
Grade 5	3
Grade 6	2
Resource	3
Literacy Specialist	5
Other Specialist	3
Junior High	1
TOTAL	37

The focus of this study was mathematics readiness in Kindergarten, so data was isolated to teachers who are currently teaching or who have taught Kindergarten when necessary.

Teaching and Learning

Participants responded to four questions in the first section of the survey. Two questions pertained to beliefs the teachers have about how children learn, while two pertained to methods participants use to teach (see Figure 9: Teaching and Learning Questions as Seen Online).

Figure 9: Teaching and Learning Questions as Seen Online

Teaching and Learning - Section 1/6

1. How do you believe children learn best? (Please select all that apply.)

<input type="checkbox"/> Children learn by constructing their own knowledge.	<input type="checkbox"/> Children learn by building on their prior knowledge.
<input type="checkbox"/> Children learn by practicing skills.	<input type="checkbox"/> Children learn by participating in developmentally appropriate activities.
<input type="checkbox"/> Children learn by working on concepts with skills that are challenging but not frustrating.	<input type="checkbox"/> Children learn by developing individual learning styles.

2. Of the beliefs selected above, which do you believe is MOST important?

Select Answer

3. Which of the following methods do you use regularly- at least once each typical school day- to teach students? (Please select all that apply.)

<input type="checkbox"/> Whole class instruction	<input type="checkbox"/> Confering one-on-one
<input type="checkbox"/> Small group work	<input type="checkbox"/> Centres
<input type="checkbox"/> Worksheets	<input type="checkbox"/> Workbooks
<input type="checkbox"/> Small group targeted instruction (i.e. guided reading)	<input type="checkbox"/> Peer-teaching (including buddies from another grade)

4. Of the methods selected above, which do you use MOST during a single typical teaching day?

Select Answer

The first and second questions in this section of the survey, pertain to beliefs about how children learn best. Six descriptors are included, and each relate to one or more influential thinkers and corresponding theories of learning (see Appendix C: Influential Thinkers and Their Theories on Mathematics Readiness and Learning and Table 4: Belief Statements and Learning Theories).

Table 4: Belief Statements and Learning Theories

Belief Statement Regarding How Children Learn Best	Learning Theory
Children learn by constructing their own knowledge.	Constructivist Theory
Children learn by building on their prior knowledge.	Cognitive Theory (conceptual)
Children learn by practicing skills.	Skill-based Theory
Children learn by participating in developmentally appropriate activities.	Developmental Theory
Children learn by working on concepts with skills that are challenging but not frustrating.	Zone of Proximal Development
Children learn by developing individual learning styles.	Theory of Multiple Intelligences

Firstly, participants reported the statements that reflect all personal beliefs of how children learn; participants could select any or all that apply. Secondly, participants reported only one descriptor to indicate the statement that most closely reflects their belief of how children learn best. For results, please see Table 5: Results of Teachers' Beliefs Regarding How Children Learn Best.

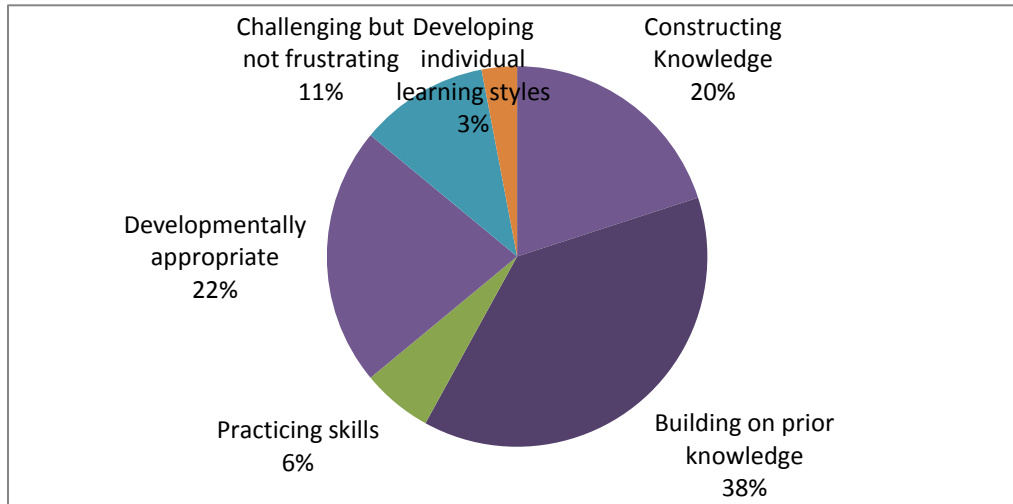
Table 5: Results of Teachers' Beliefs Regarding How Children Learn Best

Teachers'¹ Belief Statements Regarding How Children Learn Best	Q1: Select Any of the Beliefs		Q2: Select Most Important Belief	
	Mode	Rank	Mode	Rank
Children learn by constructing their own knowledge.	78%	3	20%	3
Children learn by building on their prior knowledge.	98%	1	38%	1
Children learn by practicing skills.	70%	5	5%	5
Children learn by participating in developmentally appropriate activities.	85%	2	22%	2
Children learn by working on concepts with skills that are challenging but not frustrating.	77%	4	11%	4
Children learn by developing individual learning styles.	67%	6	4%	6

¹n = 82

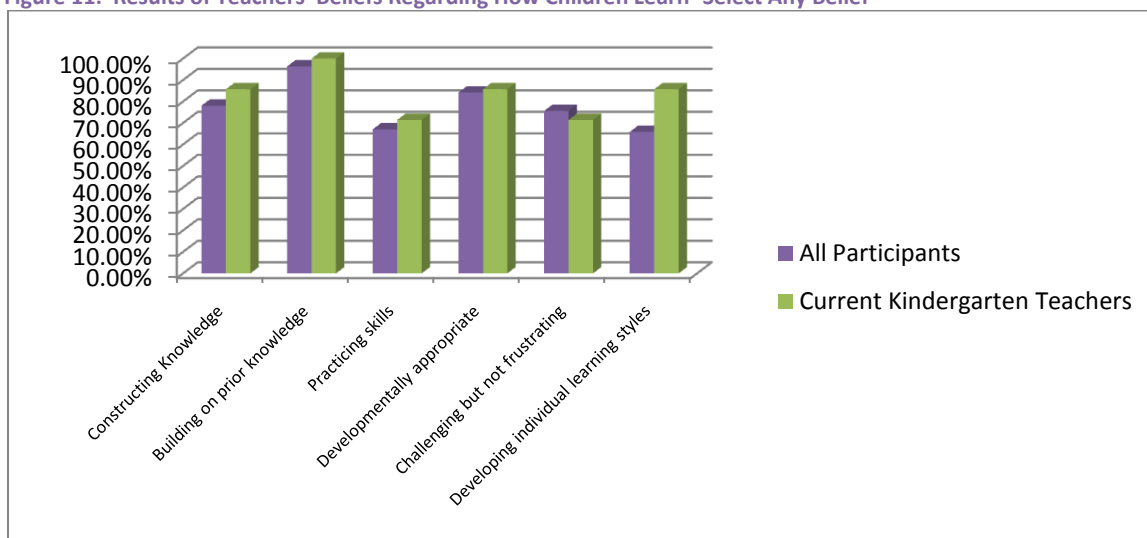
The same ranking order emerged when results for the teacher belief statements regarding how children learn best were analyzed when participants were asked to select any of the statements and when participants reported the most important belief. Most participants reported that they believe that children learn best by building on their prior knowledge, followed by participating in developmentally appropriate activities, a constructivist approach, and Vygotsky’s Zone of Proximal Development. The least important and least frequently supported belief for how children learn was the model of Multiple Intelligences (see Figure 10: Results of All Participants' Selection of the MOST Important Way Children Learn).

Figure 10: Results of All Participants' Selection of the MOST Important Way Children Learn



Results of current Kindergarten teachers' beliefs regarding how children learn tended to follow all participants' results (see Figure 11: Results of Teachers' Beliefs Regarding How Children Learn- Select Any Belief). Most Kindergarten teachers' responses were within 5% of all participants' responses; the exception to this trend in responses is that 20% more Kindergarten teachers selected the descriptor matching Gardener's Theory of Multiple Intelligences.

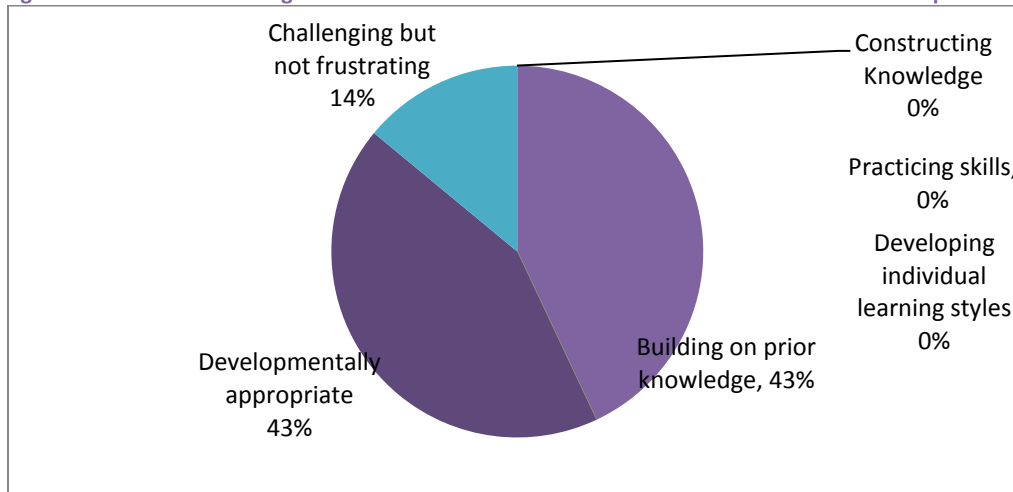
Figure 11: Results of Teachers' Beliefs Regarding How Children Learn- Select Any Belief



All current Kindergarten teachers reported “Children learn by building on their prior knowledge” as the most important belief of how children learn, both by frequency when participants could select

any response, and when asked to indicate the MOST important belief (Figure 11: Results of Teachers' Beliefs Regarding How Children Learn). Participants currently teaching Kindergarten had two popular responses when asked to select which belief was MOST important for how children learn best, “Children learn by building on their prior knowledge” and “Children learn by participating in developmentally appropriate activities” (see Figure 12: Results of Kindergarten Teachers' Selections When Asked to Indicate the MOST Important Way Children Learn). However, when looking at the frequency of each belief statement, it becomes evident that Kindergarten teachers believe that children learn in a variety of ways, as most or all participants currently teaching Kindergarten selected each belief statement (Figure 11: Results of Teachers' Beliefs Regarding How Children Learn).

Figure 12: Results of Kindergarten Teachers' Selections When Asked to Indicate the MOST Important Way Children Learn



The third and fourth questions in the Beliefs and Practice section of the survey asked participants to report regularly used teaching methods (once a day). Eight methods were presented: whole class instruction, small group targeted instruction (such as guided reading), small group work, centres, worksheets, workbooks, conferring one-on-one, and peer-teaching (including learning buddies). Consult Table 6 and Figure 13: Results of Regularly Used Teaching Methods for a summary of results.

Table 6: Results of Regularly Used Teaching Methods

Q1: Select Any of the Methods	All Participants ¹		Current Kindergarten Teachers ²	
	Mean	Rank	Mean	Rank
Whole class instruction	87%	2	100%	1
Small group targeted instruction	74%	3	86%	2
Small group work	91%	1	86%	2
Centres	51%	5	71%	3
Worksheets	40%	7	29%	5
Workbooks	23%	8	0%	6
Conferring one-on-one	73%	4	86%	2
Peer-teaching	41%	6	57%	4
Q2: Preferred (Most Used) Teaching Method	Mean	Rank	Mean	Rank
Whole class instruction	32%	1	43%	2
Small group targeted instruction	10%	3	14%	3
Small group work	32%	1	0%	
Centres	10%	3	57%	1
Worksheets	1%	4	0%	
Workbooks	1%	4	0%	
Conferring one-on-one	13%	2	0%	
Peer-teaching	1%	4	0%	

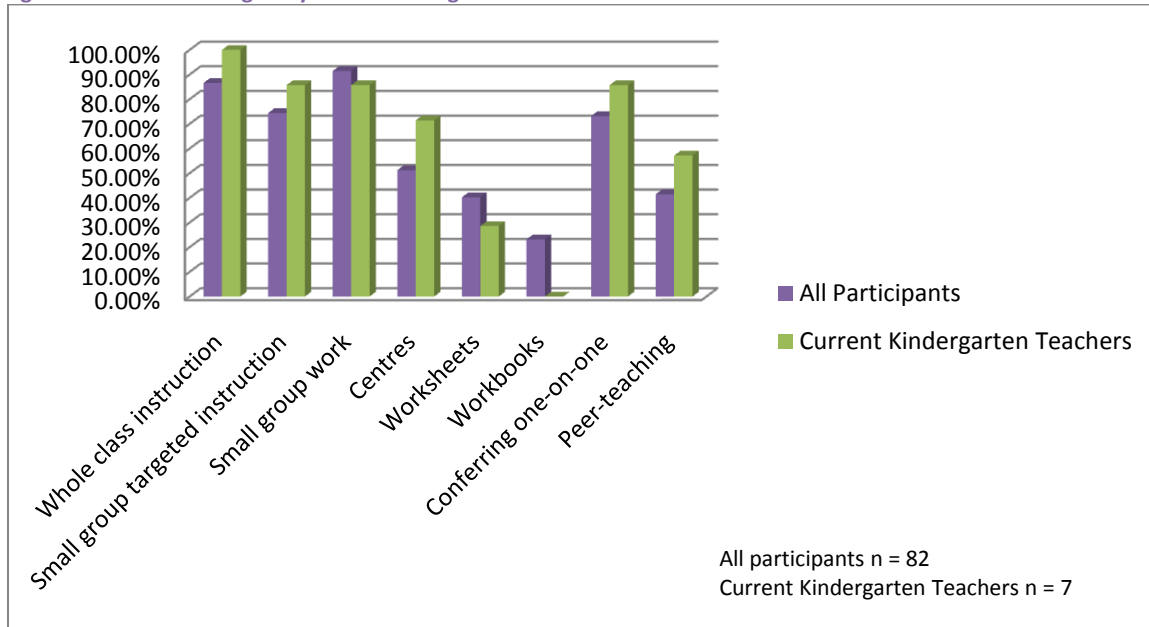
¹ n = 82

² n = 7

Worksheets (40%), workbooks (23%) and peer-teaching (41%) were reported as the least popular methods of instruction by all participants, and were each only selected by 1% of the participants as the preferred method of instruction; no Kindergarten teacher reported workbooks as a regularly used

method of instruction, and 29% reported the use of worksheets regularly. Kindergarten teachers reported using peer-teaching more regularly than all participants (59%, almost 20% more than all participants). All participants reported whole class, small groups, one-on-one instructional methods as popular methods of instruction.

Figure 13: Results of Regularly Used Teaching Methods



By isolating current Kindergarten teachers' responses, it can be observed that no one reported workbooks as a regularly used teaching method, and all reported whole class instruction. Most Kindergarten teachers reported the regular use of small group instruction, small group work and conferring one-on-one. While all participants reported small group work and whole class instruction as the primary methods of instruction, followed by conferring one-on-one, 71% of Kindergarten teachers also reported centres as a frequently used method of instruction. In fact, of the 5 Kindergarten teachers who indicated that they use centres on a daily basis, 4 selected this method as the preferred method for instruction.

When asked to choose the MOST preferred teaching method, centres, whole class instruction, and small group targeted instruction are the only instructional methods reported by participants who

are current Kindergarten teachers. When asked to identify the teaching method used most frequently, Kindergarten teachers stray from the results of all participants, and reported both centres and whole group instruction as the most frequently used methods (compare Figure 14: Results of All Participants' Preferred Teaching Methods with Figure 15: Results of Kindergarten Teachers' Preferred Teaching Methods). Most Kindergarten teachers (86%) reported regular use of one-on-one instruction, but no current Kindergarten teacher reported it as a preferred method of instruction.

Figure 14: Results of All Participants' Preferred Teaching Methods

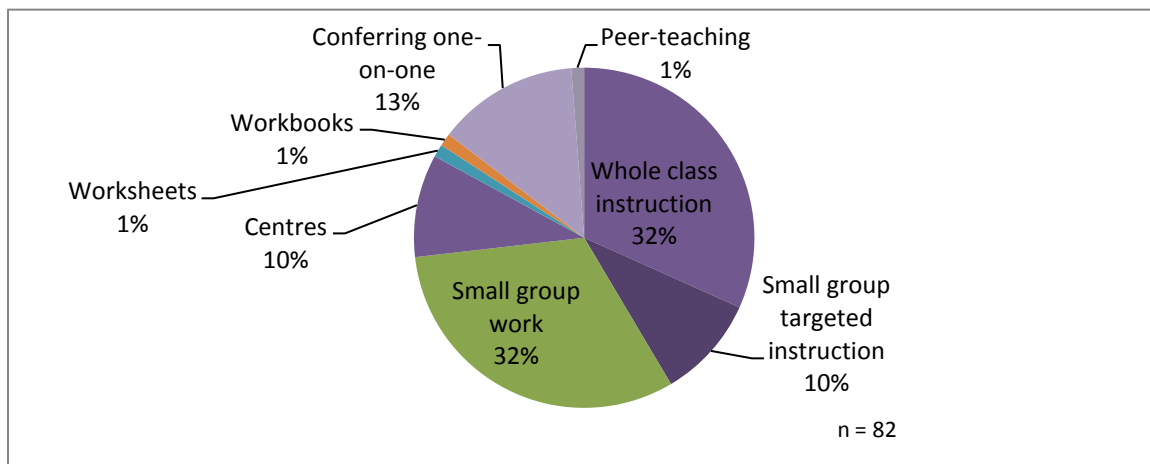
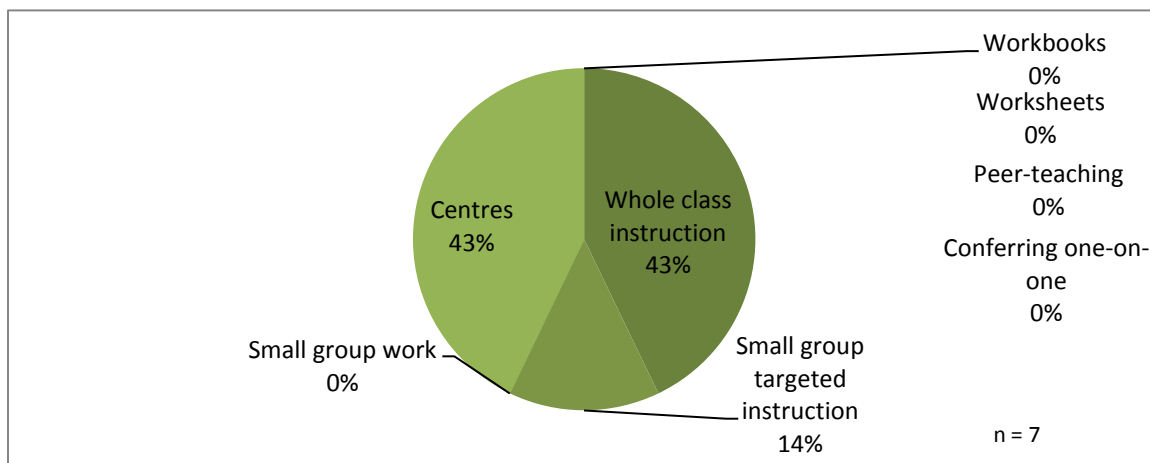


Figure 15: Results of Kindergarten Teachers' Preferred Teaching Methods



Preference for teaching methods by Kindergarten teachers is unique by comparison to the all participants, and these results are important to the study because most formal early elementary assessments (for example, Clay M. M., 1995; Connolly, 2007) are designed only for one-on-one use. Assessment used *for* learning (as opposed to assessment *of* learning) should mimic the most used form of instructional practice in order to be authentic. Evidently, results indicate that Kindergarten teachers do not believe that one-on-one instruction is efficient or manageable given the challenges of a Kindergarten classroom because no one reported one-on-one instruction as the preferred method of instruction.

Beliefs and Practice

The second section of the survey pertained to beliefs and practice of teachers’ attitudes towards literacy and mathematics. The questions isolated literacy and mathematics (see Figure 16: Beliefs and Practice Questions as Seen Online).

Figure 16: Beliefs and Practice Questions as Seen Online

The screenshot shows a survey interface with a blue header bar that reads "Beliefs and Practice - Section 2/6". Below the header, there is a prompt: "For the following questions, please select the descriptor that best describes your attitude toward each statement in regards to your belief or practice." The survey contains eight numbered statements, each followed by a horizontal row of five radio buttons. The radio buttons are labeled from left to right as "Completely disagree", "Mostly disagree", "Neutral", "Mostly agree", and "Completely agree".

Statement	Completely disagree	Mostly disagree	Neutral	Mostly agree	Completely agree
1. In my classroom, I focus mostly on literacy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. In my classroom, I focus mostly on mathematics.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I believe I am prepared for literacy instruction and assessment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I believe I am prepared for mathematics instruction and assessment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. The parents of my students expect an emphasis on literacy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. The parents of my students expect an emphasis on mathematics.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. I believe there is more support in the area of literacy than mathematics for teachers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. I believe there is more support in the area of mathematics than literacy for teachers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Below the statements is a text box labeled "Additional Comments:" with a scroll bar.

By frequency, participants reported favourable agreement with most of the positively phrased statements. The exception was statement 8 which read: “I believe there is more support in the area of

mathematics than literacy for teachers.” Results indicate that 78% of participants mostly or completely disagreed with this statement.

Table 7: Results of Beliefs and Practice Questions

	Completely Disagree	Mostly Disagree	Mostly Agree	Completely Agree
All Participants				
1. In my classroom, I focus mostly on literacy. ¹	1%	2%	51%	45%
2. In my classroom, I focus mostly on mathematics. ²	11%	33%	47%	9%
3. I believe I am prepared for literacy instruction and assessment. ¹	0%	4%	64%	32%
4. I believe I am prepared for mathematics instruction and assessment. ²	6%	14%	59%	21%
5. The parents of my students expect an emphasis on literacy. ¹	0%	12%	52%	35%
6. The parents of my students expect an emphasis on mathematics. ²	7%	19%	54%	20%
7. I believe there is more support in the area of literacy than mathematics for teachers. ¹	6%	27%	34%	33%
8. I believe there is more support in the area of mathematics than literacy for teachers. ¹	17%	61%	17%	5%
Teachers Currently Teaching Kindergarten³				
1. In my classroom, I focus mostly on literacy.	0%	0%	57%	43%
2. In my classroom, I focus mostly on mathematics.	14%	29%	43%	14%
3. I believe I am prepared for literacy instruction and assessment.	0%	0%	71%	29%
4. I believe I am prepared for mathematics instruction and assessment.	0%	14%	57%	29%
5. The parents of my students expect an emphasis on literacy.	0%	14%	29%	57%
6. The parents of my students expect an emphasis on mathematics.	0%	29%	43%	29%
7. I believe there is more support in the area of literacy than mathematics for teachers.	0%	29%	43%	29%
8. I believe there is more support in the area of mathematics than literacy for teachers.	0%	57%	43%	0%

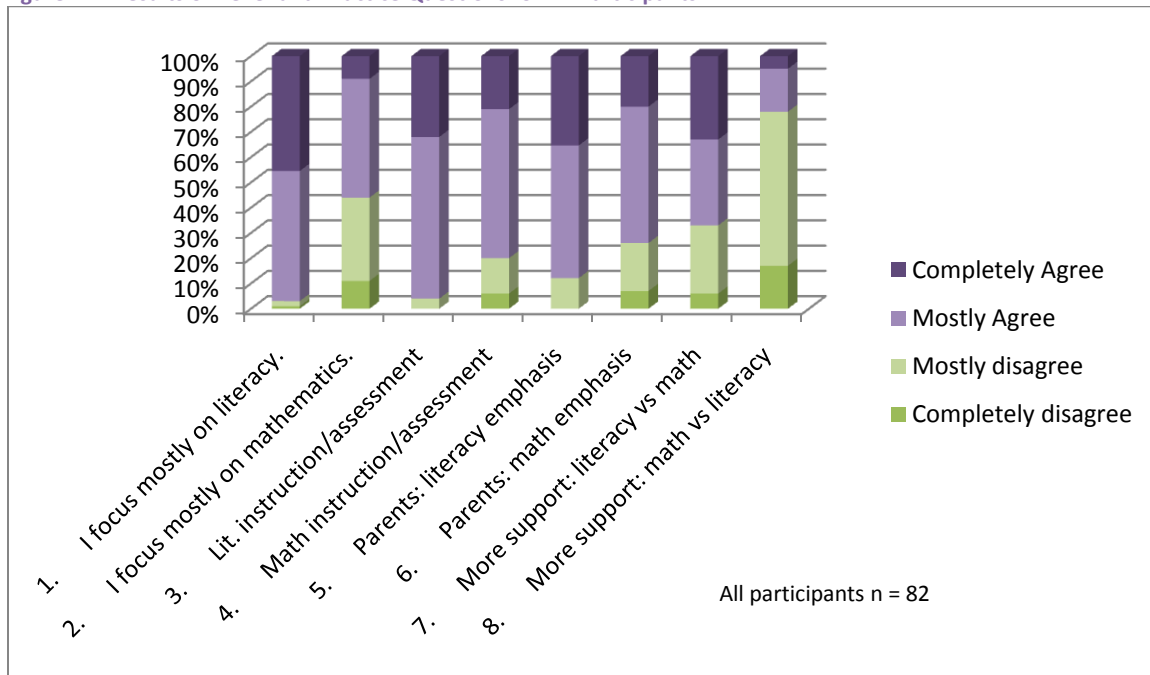
¹ n = 82

² n = 81 (due to one participant declining to answer some belief and practice questions on math due to teaching assignment)

³ n = 7

There is a discrepancy between all four pairs of Belief and Practice questions; in contrast to mathematics, literacy results to belief and practice statements are consistently more favourably reported: teachers report that they are more prepared for literacy instruction, that parents expect an emphasis on literacy, and that there is more support in literacy (see Table 7: Results of Beliefs and Practice Questions). All Kindergarten teachers reported that they mostly or completely agree that they focus mostly on literacy. In contrast, 43% of Kindergarten teachers reported that they mostly or completely disagree that they focus on mathematics.

Figure 17: Results of Belief and Practice Questions for All Participants



The consistent discrepancies reported between literacy and mathematics for each pair of statements is evident (see Figure 17: Results of Belief and Practice Questions for All Participants). The purple coding indicates endorsement of the statement, while the green coding indicates disagreement. Of note is the mostly consistent discrepancy between statements pertaining to literacy and mathematics, regardless of considering all participants or only current Kindergarten teachers. Participants reported that they more strongly agree that the focus of instruction is on literacy than mathematics, participants

feel more strongly prepared for literacy instruction and assessment than mathematics, and that the parents expect more emphasis on literacy than on mathematics.

Readiness

In the third section of the survey (see Figure 18: Readiness Questions as Seen Online), participants reported perceptions and beliefs on students’ readiness. The first question addressed general school readiness: participants were presented with 5 descriptors that influence a child’s readiness for school. Participants were asked to rank the descriptors based on influence on a child’s overall school readiness. The remaining questions in this section of the survey presented statements about readiness, specific to literacy and mathematics. Participants were asked to indicate if students are prepared for learning activities in the two curriculum areas. Participants reported whether they employ informal methods for assessing readiness in the areas of literacy and mathematics.

Figure 18: Readiness Questions as Seen Online

Readiness - Section 3/6

1. Please rank the following descriptors in the order of influence on a child’s readiness for school (1 being most influential, followed by 2, 3, 4, 5...):

- Age (birth date)
- Prior experiences
- Parental involvement
- Genetics
- Pre-school attendance
- Other

For the following questions, please select the descriptor that best describes your attitude toward each statement in regards to your belief or practice.

	Completely disagree	Mostly disagree	Mostly agree	Completely agree
2. The children who enter my class in September are ready to participate in learning activities around reading and writing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. The children who enter my class in September are ready to participate in learning activities around mathematics.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I have informal methods for assessing my students’ literacy readiness.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4b. If you answered ‘Completely agree’ or ‘Mostly agree’ for question 4 please describe informal methods you use for assessing literacy readiness below:	<input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/>			
5. I have informal methods for assessing my students’ mathematics readiness.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5b. If you answered ‘Completely agree’ or ‘Mostly agree’ for question 5 please describe informal methods you use for assessing mathematics readiness below:	<input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/>			

All participants, including the sub-sample consisting of current Kindergarten teachers, selected the same order for all readiness indicators: (1) Prior Experiences, (2) Parental Involvement, (3)

Preschool attendance, (4) Age, and (5) Genetics (see Table 8: Ranking Order of Readiness Indicators). Parental involvement is a popular indicator for school readiness across all grade level breakdowns; literature on this topic (Coates, 2004) supports these results. Some participants (8%) reported “Other” as an indicator; some examples of other indicators that participants mentioned included socio-economic status, gender, and older siblings. More than half (52%) of participants reported prior experiences as the most influential indicator of school readiness. This result is important to the study. If the most influential indicator for readiness is prior experience, then it should be a priority for teachers to have a way to assess academic understanding from these experiences.

Table 8: Ranking Order of Readiness Indicators

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6
Prior Experiences	52%	23%	17%	5%	2%	0%
Parental Involvement	35%	36%	22%	6%	1%	0%
Preschool Attendance	4%	10%	35%	27%	22%	2%
Age (birth date)	5%	21%	17%	36%	21%	0%
Genetics	7%	5%	10%	23%	51%	4%
Other Indicator	4%	1%	0%	2%	0%	2%
n = 81 (one participant declined to answer this question)						

Participants reported that they mostly or completely agreed that children enter ready to participate in both literacy (86%) and mathematics (84%) learning activities each September. Participants indicated that they have more informal methods for assessing literacy readiness than mathematics readiness (81% versus 47%). These results indicate that teachers have faith in their incoming students’ literacy and mathematics readiness, but less than half of participants reported that they were prepared to informally assess mathematics readiness. Kindergarten teachers (58%) reported

more frequently employing informal methods to assess mathematics than all participants (47%). See

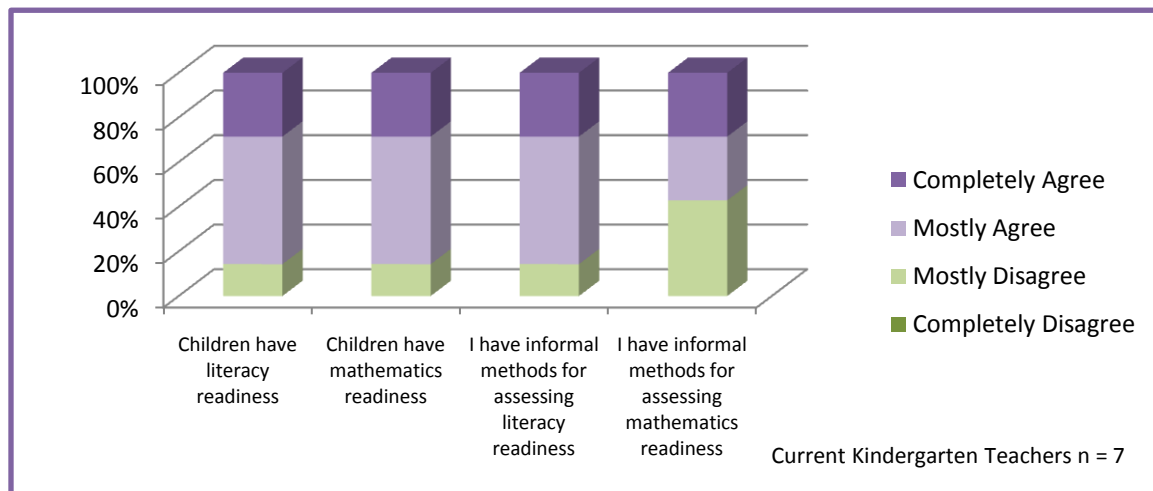
Table 9: Results of Readiness Questions for results of these readiness questions.

Table 9: Results of Readiness Questions

	Completely Disagree	Mostly Disagree	Mostly Agree	Completely Agree
Students have literacy readiness	1%	10%	66%	20%
Students have mathematics readiness	2%	12%	66%	18%
Informal method for assessing literacy readiness	2%	17%	43%	38%
Informal method for assessing mathematics readiness	7%	37%	35%	12%
n = 82				

The data indicate that teachers may require support for assessing mathematics readiness more so than literacy readiness, particularly since almost half (42%) of the Kindergarten teachers surveyed mostly or completely disagree that they have informal methods for assessing mathematics readiness (see Figure 19: Current Kindergarten Teachers' Beliefs Regarding Readiness).

Figure 19: Current Kindergarten Teachers' Beliefs Regarding Readiness



Nonetheless, 58% of Kindergarten teachers do have informal methods for assessing mathematics readiness. Kindergarten teachers reported that they assess mathematics readiness by focusing on numeracy skills: counting, recognizing, and ordering numbers, distinguishing the difference between letters and numbers, one-to-one matching, and creating groups of items that to match a number, and knowledge of their phone numbers and street number. One Kindergarten teacher reported the use of a checklist of acquired skills. Only one Kindergarten teacher mentioned using manipulatives to informally assess patterning, sorting and numeracy proficiency: “through observation and direct instruction [to] assess their interest and knowledge of math concepts applicable to Primary.”

All informal methods reported by Kindergarten teachers were described as task-based; no one indicated that they used a paper and pencil activity sheet or other traditional “test” to assess mathematics readiness, since at this grade level, literacy skills would certainly be an obstacle.

Assessment

In this section of the survey, participants reported frequently used standardized assessments and methods of assessment. Teachers also reported frequency of assessments for their instructional purposes and preference of assessment methods with classroom and time management considerations (see Figure 20: Assessment Questions as Seen Online).

Figure 20: Assessment Questions as Seen Online

Assessment - Section 4/6

1. Please indicate which of the following standardized assessments you use with your students: (Select all that apply.)

<input type="checkbox"/> Marie Clay's An Observational Survey	<input type="checkbox"/> Running Records
<input type="checkbox"/> Concepts of Print	<input type="checkbox"/> Sight word lists
<input type="checkbox"/> Prime math assessments	<input type="checkbox"/> KeyMath
<input type="checkbox"/> Other	

If you have selected "Other," please indicate other standardized assessments you use with your Kindergarten students:

2. Please indicate the types of assessments you use with your students: (Select all that apply.)

<input type="checkbox"/> Observation	<input type="checkbox"/> Checklists
<input type="checkbox"/> Written samples (i.e. worksheets, tests, journals)	<input type="checkbox"/> One-on-one conferencing
<input type="checkbox"/> Other	

If you have selected "Other," please indicate other types of assessments you use with your Kindergarten students:

3. How frequently do you assess your students for instructional planning?

Select Answer

4. Considering classroom and time management issues, which type of assessments do you prefer?

Select Answer

5. How do you organize your classroom to create time to assess your students?

Most participants reported that they use Marie Clay's "Running Records", a sub-test of the *Observational Survey* (see Table 10: Results of Standardized Assessments Question). All current Kindergarten teachers surveyed reported using "Running Records" and "Concepts of Print" (please note that these are two subtests of Marie Clay's *Observational Survey*), and most use sight word lists. No Kindergarten teacher reported using either of the standardized math assessment *KeyMath* or *PRIME* assessment materials. This is not surprising given the inaccuracies that can occur when applying these standardized assessments to the youngest school population. In fact, *PRIME* materials are not recommended for use until the final term of the first school year. No Kindergarten teacher reported another standardized test used for mathematics assessment for that grade level. This lack of standardized mathematics assessments for Kindergarten teachers is particularly troublesome because it has already been established that almost half (43%) of current Kindergarten teachers surveyed reported that they do not have informal methods to assess mathematics readiness (see Table 9: Results of Readiness Questions).

Table 10: Results of Standardized Assessments Question

	A01-1 Observational Survey	A01-2 Running Records	A01-3 Concepts of Print	A01-4 Sight word list	A01-5 PRIME assessments	A01-6 KeyMath	A01-7 Other
All Participants¹	30%	82%	38%	59%	21%	17%	23%
Current Kindergarten Teachers²	43%	100%	100%	86%	0%	0%	0%

¹ n = 81

² n = 7

Nearly all participants, and indeed every current Kindergarten teacher, reported using observation, written samples and one-on-one conferencing as methods of assessment on a regular basis (see Table 11: Results of Methods of Assessment Question). Kindergarten teachers also reported the use of checklists, self-reflections and other assessment methods more regularly than all participations. This indicates the wide variety of methods Kindergarten teachers use regularly to gather information about their students.

Table 11: Results of Methods of Assessment Question

	A02-1 Observation	A02-2 Checklists	A02-3 Written samples	A02-4 One-on-one conferencing	A02-5 Self-reflections	A02-Others
All Participants¹	99%	72%	96%	91%	56%	20%
Current Kindergarten Teachers²	100%	86%	100%	100%	71%	29%

¹ n = 82

² n = 7

Participants reported that most assess students for daily or weekly instructional planning (see Table 12: Results of Frequency of Assessments Question). More than half of current Kindergarten teachers reported assessing daily, though some reported assessing weekly, monthly or when growth is noticed.

Table 12: Results of Frequency of Assessments Question

	A03-1 Daily	A03-2 Weekly	A03-3 Monthly	A03-4 By term	A03-5 When I notice growth
All Participants¹	40%	44%	9%	2%	5%
Current Kindergarten Teachers²	57%	14%	14%	0%	14%

¹ n = 82

² n = 7

More than half of all participants (53%) reported preferring small group assessments (see Table 13: Results of Preferred Method of Assessment (considering classroom and time management)). More than a quarter of participants (30%) preferred one-on-one assessments, and many reported that they set the rest of the class to work with independent or small group work in order to be able to assess one-on-one.

Table 13: Results of Preferred Method of Assessment (considering classroom and time management)

	A04-1 One-on-one	A04-2 Small groups	A04-3 Whole class
All participants¹	30%	53%	15%
Current Kindergarten Teachers²	29%	57%	14%

¹ n = 82

² n = 7

Current Kindergarten teachers elaborated on how they organize their classrooms to accommodate small group (57%) or one-on-one (29%) assessments: they use centres or independent activities to meet with individuals or one-on-one, and some highlighted the importance of routines (such as morning routines or reading/writing workshops) to schedule regular assessment times.

Preparedness

Figure 21: Preparedness Questions as They Appear Online

Preparedness - Section 5/6

Please recall the lowest grade level class you have ever taught for this section. Imagine it is one month into the school year with your class. Please indicate how prepared you would be to evaluate each of the following skills or concepts based on assessments (including observation) that you would have done only within the month of **September**. This does not mean that the students will have achieved all these skills or concepts, but rather that you would have an informed assessment of the child's current ability.

Recall the lowest grade level you have ever taught: At the end of September, consider how prepared would you be to comment on each child's ability to...

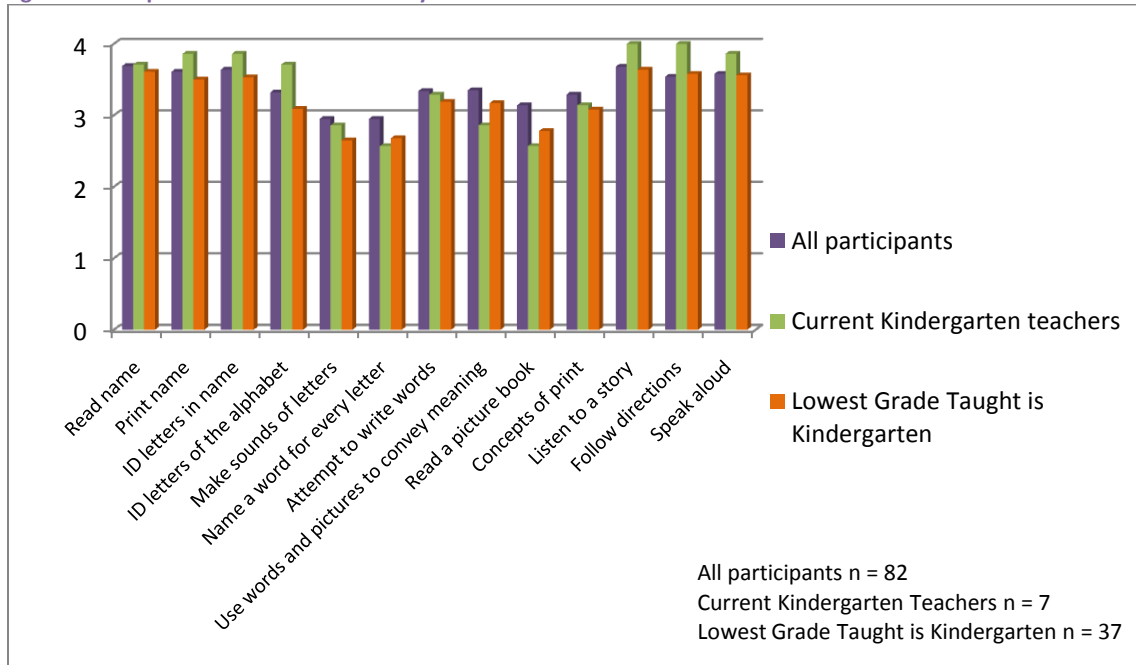
	Completely unprepared	Mostly unprepared	Mostly prepared	Completely prepared
1. Read his or her own name	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Print his or her own name	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Identify letters in his or her own name	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Identify all the letters in the alphabet (out of order)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Make corresponding sounds for all the letter in the alphabet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. Name a word that begins with each letter in the alphabet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Attempt to write words	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Use words and pictures to convey meaning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. Read a simple picture book	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Demonstrate concepts of print	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. Listen to a story	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. Follow directions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. Speak aloud	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Additional comments on preparedness for commenting on each child's literacy abilities in September:				
<div style="display: flex; justify-content: space-around;"> Completely unprepared Mostly unprepared Mostly prepared Completely prepared </div>				
Recall the lowest grade level you have ever taught: At the end of September, consider how prepared would you be to comment on each child's ability to...				
14. Count to 10	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. Print the numerals 0-9	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16. Identify numerals 0-9 (out of order)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17. Order numbers 0-10	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18. Identify shapes (circle, square, triangle, rectangle, oval, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19. Measure with non-standard unit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. Reproduce patterns	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21. Create patterns	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22. Extend patterns	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23. Demonstrate an understanding of broad time concepts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24. Show addition situations (with manipulatives)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25. Show subtraction situations (with manipulatives)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
26. Help to create graphs based on likes/dislikes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Additional comments on preparedness for commenting on each child's mathematics abilities in September:				

Results of the Preparedness questions provide insight into the responses from the Belief and Practice section (see Table 7: Results of Beliefs and Practice Questions). Kindergarten teachers reported that they are mostly or completely confident in literacy instruction and assessment, but 14% felt mostly unprepared for mathematics instruction and assessment (see Table 7: Results of Beliefs and Practice Questions). This section of the survey asked participants to recall the lowest grade they have ever taught; this direction allows for analysis of all participants ($n = 82$), current Kindergarten teachers ($n = 7$), and teachers who indicated Kindergarten as the lowest grade taught ($n = 38$). A series of 13 items were presented for literacy, and another 13 items were presented for mathematics (see Figure 21: Preparedness Questions as They Appear Online).

Participants reported being generally well-prepared to assess the literacy indicators by the end of September (see Table 14: Results of Preparedness for Assessing Mathematics and Literacy Readiness at the End of September Questions). All participants most frequently reported that they are prepared for assessment of each literacy item within one month of school. In fact, results indicate that five literacy items are at least one standard deviation above the mode for all items: the three skills associated with the child's name (reading, printing, and naming each letter), along with listening and speaking skills. Current Kindergarten teachers added two other literacy items that are one standard deviation above average: identifying all the letters of the alphabet and following directions. No literacy item is below the standard deviation. Current Kindergarten teachers did report that naming a word for each letter and reading a picture book would be skills that they would be less prepared to assess by the end of September (this means that the mode for the results to each item is more than one standard deviation below the average response to all participants). The 37 participants who reported Kindergarten as the last grade taught indicated that they would be less prepared to assess each child's ability to generate the corresponding sound and a word for each letter of the alphabet. Current Kindergarten teachers were less confident assessing phonetic skills and word association for every letter

of the alphabet, early writing (using words and/or pictures) and early reading skills. All participants were confident assessing children’s ability to read, print and identify letters in their own name and identifying letters of the alphabet; all were also confident in having enough information to assess each child’s listening and speaking skills (Figure 22: Preparedness to Assess Literacy Indicators).

Figure 22: Preparedness to Assess Literacy Indicators



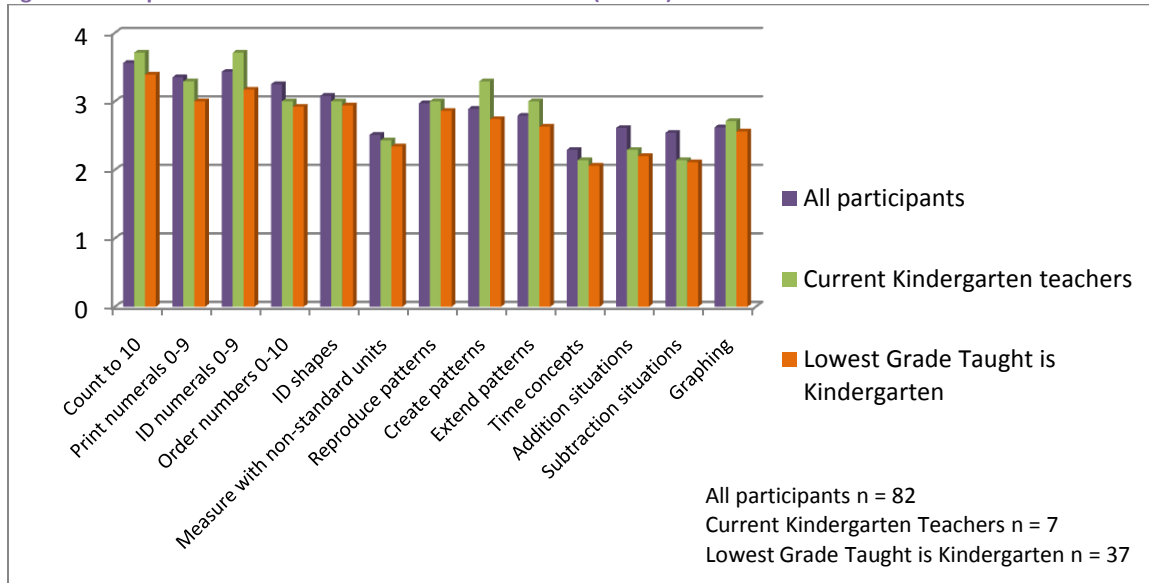
In contrast to the literacy indicators, participants reported that they are not as prepared to assess mathematics items by the end of September. Some participants noted qualitatively that not every strand in mathematics is introduced in September, so accurate assessment of each child’s readiness for all strands would not be appropriate or possible. This may be true, but it is interesting to note that most participants reported that they can observe every strand for language (reading and viewing, writing and representing, speaking and listening) in September. In fact, most participants reported being completely prepared to assess every language indicator in September.

Table 14: Results of Preparedness for Assessing Mathematics and Literacy Readiness at the End of September Questions

	All Participants ¹			Current Kindergarten Teachers ²			Lowest Grade Taught is Kindergarten ³		
	Mean	Median	Mode	Mean	Median	Mode	Mean	Median	Mode
<u>Language Indicators</u>									
Read name	3.69	4	4	3.71	4	4	3.61	4	4
Print name	3.61	4	4	3.86	4	4	3.50	4	4
ID letters in name	3.64	4	4	3.86	4	4	3.53	4	4
ID letters of the alphabet	3.32	3	4	3.71	4	4	3.09	3	4
Make sounds of letters	2.95	3	4	2.86	3	2	2.65	3	2
Name a word for every letter	2.95	3	4	2.57	2	2	2.68	3	2
Attempt to write words	3.34	4	4	3.29	3	4	3.19	3	3
Use words/pictures (writing)	3.35	4	4	2.86	3	2	3.17	3	3
Read a picture book	3.14	3	4	2.57	2	2	2.78	3	3
Concepts of print	3.29	3	4	3.14	3	4	3.08	3	3
Listen to a story	3.68	4	4	4.00	4	4	3.64	4	4
Follow directions	3.54	4	4	4.00	4	4	3.58	4	4
Speak aloud	3.58	4	4	3.86	4	4	3.56	4	4
LANGUAGE SUMMARY									
M	3.39			3.41			3.24		
SD	0.26			0.55			0.36		
<u>Mathematics Indicators</u>									
Count to 10	3.56	4	4	3.71	4	4	3.39	3	4
Print numerals 0-9	3.35	4	4	3.29	3	3	3.00	3	4
ID numerals 0-9	3.43	4	4	3.71	4	4	3.17	3	4
Order numbers 0-10	3.25	3	4	3.00	3	3	2.92	3	4
ID shapes	3.08	3	3	3.00	3	3	2.94	3	3
Measure (non-standard units)	2.51	2	2	2.43	2	2	2.34	2	2
Reproduce patterns	2.97	3	3	3.00	3	3	2.86	3	3
Create patterns	2.89	3	3	3.29	4	4	2.74	3	4
Extend patterns	2.79	3	3	3.00	3	3	2.63	3	3
Time concepts	2.29	2	2	2.14	2	2	2.06	2	2
Addition situations	2.61	3	3	2.29	2	2	2.20	2	1
Subtraction situations	2.54	3	3	2.14	2	2	2.11	2	1
Graphing	2.62	3	3	2.71	3	3	2.56	3	1
MATHEMATICS SUMMARY									
M	2.91			2.90			2.69		
SD	0.68			0.75			0.67		
Table Summary									
Mean	3.15			3.15			2.96		
Standard Deviation	0.41			0.59			0.47		
¹ n = 82									
² n = 7									
³ n = 37									
denotes larger than one SD (0.41) based on all participants (above the mean of 3.15)									
denotes larger than one SD (0.41) based on all participants (below the mean of 3.15)									

All participants, including the sub-samples of current and past Kindergarten teachers, indicated complete preparedness (by mode) for only 2 of 13 mathematics items: counting and identifying numerals. In contrast, participants reported that they were completely prepared to assess more than half (7 of 13) of the literacy items (refer to Table 14: Results of Preparedness for Assessing Mathematics and Literacy Readiness at the End of September Questions). Language appears to be approached holistically, and is infused into every activity and routine of the classroom; in contrast, mathematics is reported anecdotally by participants to be treated separately in accordance with the segregated math strands. Current Kindergarten teachers reported that they were also confidently prepared to assess patterning. All participants, including the sub-samples of current and past Kindergarten teachers, reported more concern regarding assessment of measurement, time, pre-operation (addition and subtraction) and data management items (see Figure 23: Preparedness to Assess Mathematics Indicators). The trend for the literacy items was to have all but a small few within or above one standard deviation of the mean for all participants. However, more than half of the mathematics items reported by teachers who indicated the lowest grade taught as Kindergarten fell below the standard deviation of the mean (see the sub-sample “Lowest Grade Taught is Kindergarten” in Table 14: Results of Preparedness for Assessing Mathematics and Literacy Readiness at the End of September Questions). Teachers who indicated Kindergarten as the lowest grade taught reported that the three mathematics items associated with patterning (reproduce, create and extend patterns) below the standard deviation for all participants. All participants reported counting to 10 to be one standard deviation above the mean. Current Kindergarten teachers reported that they would be very prepared to assess students’ abilities to identify the numerals 0-9 out of order (see Figure 23: Preparedness to Assess Mathematics Indicators).

Figure 23: Preparedness to Assess Mathematics Indicators (means)



All participants were given the opportunity to make additional comments following the literacy and mathematics items. One participant reported a personal observation linking literacy and mathematics readiness: “I find if a child is low in print/letter awareness, they are lower in numeracy.” Many current Kindergarten teachers expressed some concern about commenting on the mathematics items at the end of September. One Kindergarten teacher wrote: “I am introducing the children to exploration of these concepts, yet due to the focus of establishing routines and classroom expectations, assessing these skills would probably not be reasonable until well into October or November.” Another reported, “Commenting on some of the topics would depend on what I had taught in September. I would probably focus on just a few of these topics in September, but would assess the other topics throughout the rest of the year.” Similar comments reporting reluctance to report on all mathematics items were not consistently noted below the language items. All Kindergarten literacy and mathematics items selected for the survey correspond to the entire academic year’s outcomes, so it is noteworthy that the qualitative data highlights more hesitancy to be prepared to assess mathematics readiness compared to literacy readiness.

Support

In the sixth and final section of the online survey, participants reported the support they perceive they have from three levels of organization: their school administration, their school board, and their provincial education department.

Figure 24: Support Questions as Seen Online

Support - Section 6/6

For the following questions, please select the descriptor that best describes your attitude toward each statement in regards to your belief or practice.

1. I feel supported by my school administration in the area of literacy readiness. Completely disagree Mostly disagree Mostly agree Completely agree

2. I feel supported by my school board in the area of literacy readiness.

3. I feel supported by my provincial education department in the area of literacy readiness.

4. If you answered **'Mostly Agree'** or **'Completely Agree'** to any question (1-3), please describe how you feel supported in the area of **literacy readiness**:

5. If you answered **'Mostly Disagree'** or **'Completely Disagree'** to any question (1-3), please describe how you would like to be supported in the area of **literacy readiness**:

6. I feel supported by my school administration in the area of mathematics readiness. Completely disagree Mostly disagree Mostly agree Completely agree

7. I feel supported by my school board in the area of mathematics readiness.

8. I feel supported by my provincial education department in the area of mathematics readiness.

9. If you answered **'Mostly Agree'** or **'Completely Agree'** to any question (6-8), please describe how you feel supported in the area of **mathematics readiness**:

10. If you answered **'Mostly Disagree'** or **'Completely Disagree'** to any question (6-8), please describe how you would like to be supported in the area of **mathematics readiness**:

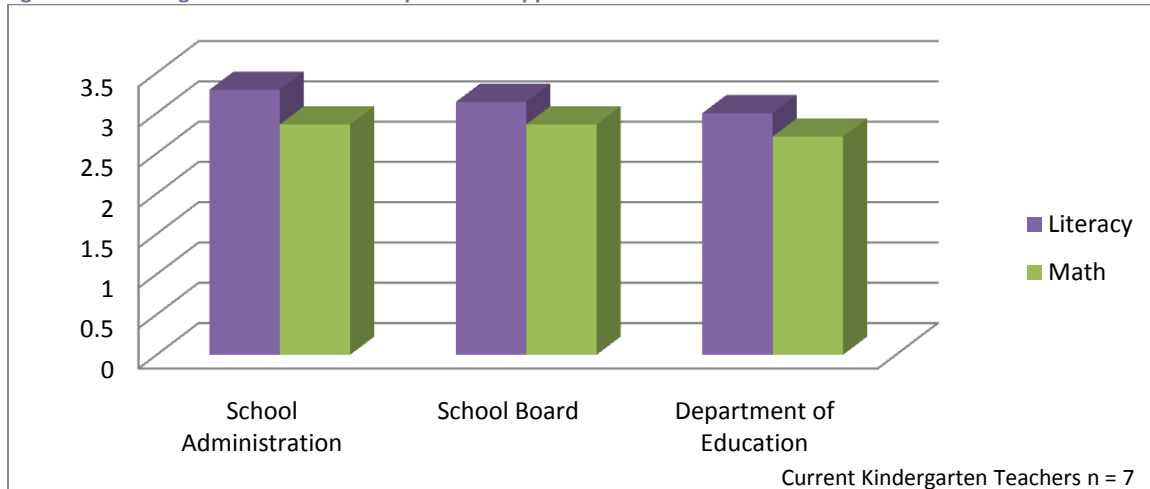
Participants reported feeling more supported by their school administration more than the school board or the provincial education department. The further removed an agency was from the classroom, the teachers reported perceptions of less support. All participants reported favourable perceptions of support in both literacy and mathematics, although participants consistently report higher levels of support in literacy than mathematics (see Table 15: Results of Support in the Area of Readiness Questions).

Table 15: Results of Support in the Area of Readiness Questions

		Completely Disagree	Mostly Disagree	Mostly Agree	Completely Agree
All Participants¹					
Literacy	School Administration	1%	12%	43%	40%
	School Board	1%	17%	45%	34%
	Provincial Dept. Of Ed.	4%	17%	52%	23%
Math	School Administration	1%	20%	50%	22%
	School Board	1%	22%	48%	21%
	Provincial Dept. Of Ed.	4%	26%	49%	13%
Current Kindergarten Teachers²					
Literacy	School Administration	0%	0%	43%	57%
	School Board	0%	14%	57%	29%
	Provincial Dept. Of Ed.	0%	14%	57%	29%
Math	School Administration	0%	14%	57%	29%
	School Board	0%	14%	57%	14%
	Provincial Dept. Of Ed.	0%	14%	71%	14%
¹ n = 82					
² n = 7					

In the Beliefs and Practice section of the survey, participants reported a perception of less support in mathematics than literacy (see Table 7: Results of Beliefs and Practice Questions, page 91). Once again, discrepancies between literacy and mathematics can be observed (Figure 25: Kindergarten Teachers' Perceptions of Support in Readiness).

Figure 25: Kindergarten Teachers' Perceptions of Support in Readiness



Participants' qualitative responses on the topic of support usually praised people involved in mathematics education, such as math mentors, math coaches and other qualified support personnel, not purchased items or programs:

We have a great math resource in our school... the resource teacher. If she were not there, then we would be left to talk to ourselves and other staff who are unmotivated to improve their teaching methods in mathematics. More PD opportunities are needed, especially in a small school. You do not have other "same grade" teachers to conference with, so at times you feel very isolated in your profession. It would be nice if we had a math coordinator who was at our school a couple of times a week to offer his or her knowledge and support to the staff. It would also be helpful if the board would offer more than just one PD session in the summer for teachers who want to refresh their knowledge.

Nonetheless, participants reported frustration with the support provided by the organizations, particularly with mathematics support. One participant wrote, "I wonder if [the board and department] actually took into account real teachers who are trying to teach real students." Another reported, "it seems we are on our own with the teaching of math. I don't know who our math rep is nor our math

resource person. I have not been asked to attend any workshops on mathematics through our board.” Some participants have been actively seeking their own opportunities for mathematics professional development, while others are in schools that are receiving intensive training and piloting programs such as *PRIME* (Small, 2004-2007). Some participants reported that most professional development has focused more on literacy and less on mathematics. Participants reported time, manipulatives, and excessive outcomes as barriers to the support they require to deliver an effective curriculum.

Discussion of the Results

What effective mathematics readiness assessment strategies do Kindergarten teachers use?

The motivation for this study is from my experience as a Kindergarten teacher; in my experience, a number of Kindergarten teachers assess mathematics readiness with less focused strategies than literacy readiness. Indeed, the results of this research study indicate that this is true. Kindergarten teachers reported that they focus on literacy more than on mathematics, that they feel more prepared for literacy assessment and instruction, that they feel parents expect an emphasis on literacy, and that there is more support for literacy than mathematics. Teachers reported that they are consistently more prepared to report on literacy items of readiness by the end of September than mathematics items. Teachers commented on the daunting task of assessing all mathematics items in September, though no similar comments were noted concerning literacy items. Teachers reported that they feel more supported in the area of literacy readiness than mathematics readiness at all levels of organization. Teachers reported that they have more informal literacy readiness assessments than mathematics, and most of these were focused exclusively on numbers. In fact, Kindergarten teachers did not report the use of any standardized assessments to assess children’s knowledge in mathematics for instructional planning, but all Kindergarten teachers reported use of standardized assessments for literacy.

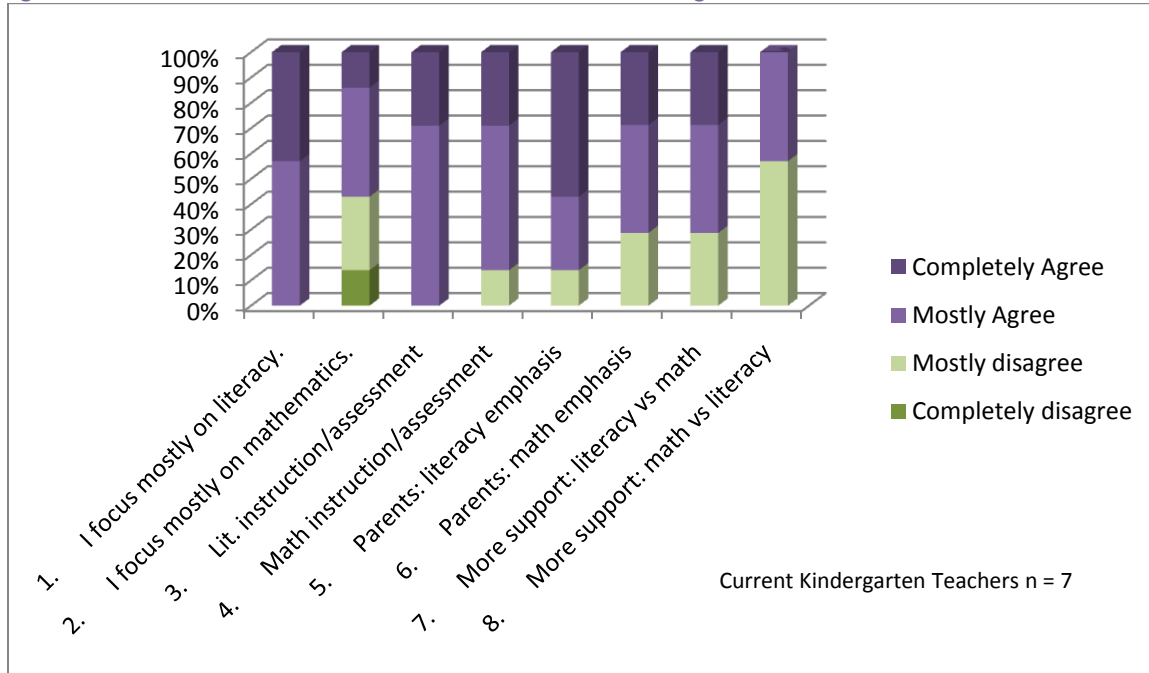
Are Kindergarten teachers' preparedness and willingness to assess mathematics readiness significantly different from their preparedness and willingness to assess literacy readiness?

Most Kindergarten teachers reported prior experiences as the most important indicator for school readiness. They reported beliefs that children are equally ready for literacy- and mathematics-learning activities in their classrooms, but almost half of the surveyed Kindergarten teachers do not use informal methods for assessing mathematics readiness, and no Kindergarten teacher reported using any standardized assessment for mathematics. Results of this study indicated that Kindergarten teachers who do assess mathematics readiness do so very informally and do not have access to formal mathematics readiness assessment tools. Kindergarten teachers reported that they are less prepared to assess and monitor mathematics readiness and achievement than literacy. Kindergarten teachers reported beliefs that children learn by building on their prior knowledge and participating in developmentally appropriate activities.

Kindergarten teachers' reported beliefs about mathematics and literacy are similar to results of all participants (see Figure 26: Results of Belief and Practice Questions for Current Kindergarten Teachers and Figure 17: Results of Belief and Practice Questions for All Participants). All Kindergarten teachers reported that they completely or mostly agree that they focus on literacy; in contrast, almost half reported that they completely or mostly do NOT focus on mathematics. All Kindergarten teachers reported that they believe they are prepared for literacy instruction and assessment, whereas 14% reported that they were mostly unprepared for mathematics instruction and assessment. More than half of Kindergarten teachers completely agree that parents expect an emphasis on literacy, and almost 30% reported that parents mostly do not expect an emphasis on mathematics. Nearly 60% of Kindergarten teachers reported feeling mostly unsupported in the area of mathematics readiness; in fact, almost 30% reported that they also believe that they are unsupported in literacy readiness. These

results indicate that Kindergarten teachers need more support in the area of readiness, particularly in mathematics readiness.

Figure 26: Results of Belief and Practice Questions for Current Kindergarten Teachers



Conclusion to the Chapter

The purpose of this study was to survey Kindergarten teachers to determine how individual teachers currently assess their students’ mathematics readiness. From the results, I can determine that there is a perceived need for a common mathematics readiness assessment tool. Current Kindergarten teachers surveyed do not use standardized mathematics assessments with their students, and less than half have informal ways to assess mathematics readiness. In contrast, Kindergarten teachers report better support for assessment and readiness for the area of literacy than mathematics. Without proper support for readiness assessment, Kindergarten teachers must proceed with instructional planning based on the outcomes for the grade level, rather than where each child is in their mathematical understanding. I believe that instruction should be based on where the individual children are in their own mathematical understanding. When teachers can base instructional planning to meet the children

where they are in their understanding of mathematics, instruction results in the students *meeting* the outcomes, not merely *covering* the topics involved in the outcomes.

This study gathered information on teachers' assessment of their students' prior knowledge necessary for meeting Kindergarten mathematics outcomes. The results of the survey allow me to determine whether they desire or require support in determining students' readiness for Kindergarten mathematics instruction. The next chapter concludes this study. I summarize important points from the Introduction, Literature Review, Methodology, and Results chapters of this report. I highlight themes that have emerged from the results of the study, and place them in context with existing research in this area. I make important remarks on implications for further study based on the results of this study, and determine that a common formal assessment tool would be beneficial for Kindergarten teachers.

Chapter 5: Conclusion to the Thesis

Teachers and developers of instructional materials sometimes assume that students need to be a certain age to learn certain mathematical ideas. However, a major research finding is that what is developmentally appropriate is largely contingent on prior opportunities to learn. Claims based on theories that children of particular ages cannot learn certain content because they are “too young,” “not in the appropriate stage,” or “not ready” have consistently been shown to be wrong. Nor are claims justified that children cannot learn particular ideas because their brains are insufficiently developed, even if they possess the prerequisite knowledge for learning the ideas

(National Mathematics Advisory Panel, 2008, p. 20).

We live in a society and time that values setting goals, expectations, and standards for education. Students participate in learning experiences determined by a mathematics curriculum that aims to foster problem-solving skills, competence with operations, fluency between mathematical strands, and critical thinking abilities. The outcomes of the Kindergarten mathematics curriculum are achievable for most children. However, it is important to remember that teachers do not teach curriculum; they teach children. To teach children and to help them make sense of the world through the lens of mathematics, teachers must understand the complex, non-linear, spiral continuum of mathematics learning and situate every child on the continuum. Every person follows his or her own unique path toward higher mathematical reasoning, and informed teachers can gently guide students toward more complex mathematical concepts through carefully chosen activities. Curriculum may provide a plan, set benchmark goals, and specify expectations, but everyone learns mathematics in meaningful ways that are specific to personal experiences, interests, and development. There is a trajectory for mathematics learning and understanding, but most people deviate from the norm; this

trajectory is set by curriculum, the tangents people take are what make mathematics meaningful. The unique relationship each person has with learning is not exclusively dependent on curriculum authors' decisions regarding depth, sequence, emphasis, or pacing; learning does not happen in a vacuum; it is dependent on people and the experiences that influence, support, and motivate them.

The current intended mathematics curricula in Canada are based on the National Council of Teachers of Mathematics (NCTM) *Standards* (1989) and on a number of developmental theories. Many children learn from teachers following such curricula, but curricula have limitations and are based on assumptions. Specifically, the Kindergarten curriculum assumes that all children entering Kindergarten are ready to learn the mathematical concepts at that grade level. The effectiveness of Kindergarten instruction and the resulting student learning is a function of each child's prior experiences and knowledge about the world. Teachers need better support to assess mathematics readiness so that children lacking the necessary prerequisite experiences are given in-class opportunities to learn the prerequisite mathematical concepts that the curriculum anticipates children have prior to formal schooling. Likewise, when children are meeting and exceeding curriculum expectations, providing rich activities that take advantage of young children's growing and learning brain is necessary. The National Mathematics Advisory Panel (2008) reports that children are able to learn mathematics at younger ages than current curriculum expectations indicate. To support recommendations that mathematical ideas and theories can and should be accessible to young children, teachers need information: they need research-based professional development and ongoing support; they need to be able to be critical of resources and textbooks that usually address mathematical concepts only superficially; and, they need as much information as possible about each child's readiness for learning. The best support teachers can provide to their students is dependent on their understanding of each child's unique experience for learning. Of course, developmental knowledge about how children learn must be integrated with research-determined mathematics expectations. Nonetheless, a shift must occur from waiting for

children to be ready to that of assisting and fostering the readiness in the students. Students around the world are outperforming North American children (National Mathematics Advisory Panel, 2008). According to the NMAP, curricula in the most mathematically proficient nations encourage attainment of mathematical concepts, and expectations are high for their youngest children.

Part of understanding each child's unique experience for learning is to assess his or her readiness for learning specific concepts. Results of this study indicate that Kindergarten teachers require more support in the area of mathematics readiness. The five years of experience preceding Kindergarten are contributors to specific academic readiness. Teachers must be able to assess the necessary prior knowledge for developing mathematical concepts; assessment of prior knowledge is vital for effective instructional planning. Should some children lack the necessary prior knowledge, teachers must be prepared to forestall proceeding with Kindergarten mathematics outcomes in order to provide all children with the necessary prerequisite mathematics knowledge.

With the aid of a researcher-developed online survey, this study gathered information from teachers on their perceptions and beliefs about mathematics readiness. Specifically, the study aimed to uncover if Kindergarten teachers assess mathematics readiness less than literacy readiness and to learn of the reasons for this.

Immediate Implications

Kindergarten Teachers Need Research-Based Support in Mathematics Readiness.

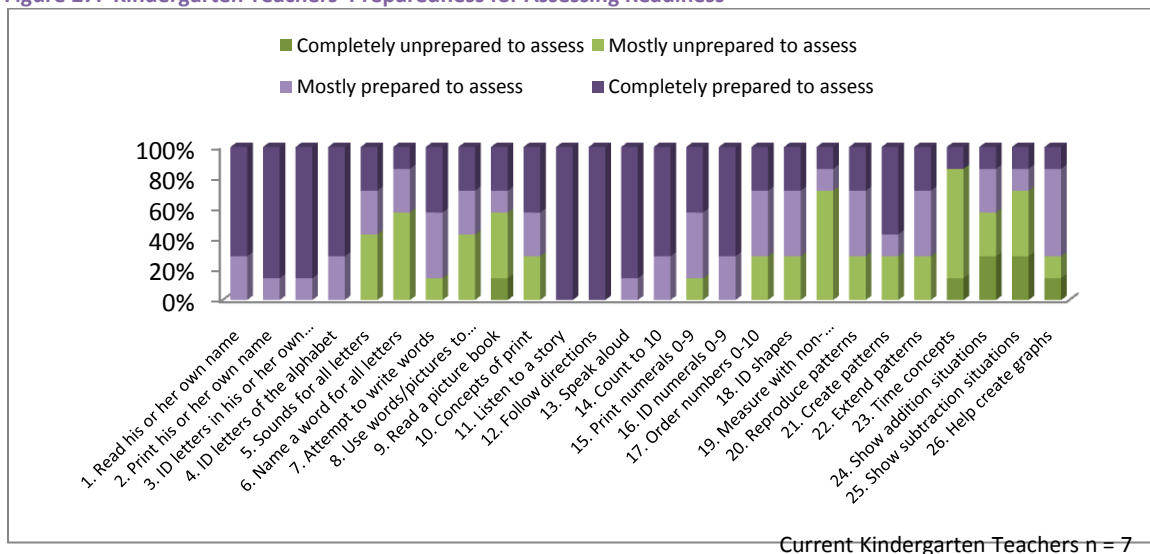
There are few research studies specifically dedicated to mathematics readiness. Literature on mathematics readiness is usually included in broader school readiness studies; even then, mathematics is usually limited to numeracy (Human Resources and Social Development Canada, 2007a; 2007b). Influential thinkers on mathematics understanding, learning, and instruction, including Piaget, Gardner,

Dienes, the Van Heiles, and Vygotsky, contribute to teachers' beliefs on how children learn mathematics. Research in the area of children's early number concepts (Box & Scott, 2004; Sarnecka & Gelman, 2004; Wynn, 1992; Sarnecka, Kamenskaya, Yamana, Ogura, & Yudovina, 2007; Sfard & Lavie, 2005; Zhou, Wang, Wang, & Wang, 2006; Lipton & Spelke, 2006; Rogers, 2007; Carol & Ray, 2003) along with the research in the emerging area of Mathematics Learning Disabilities (Mazzocco M. M., 2005; Mazzocco & Myers, 2003; Mazzocco & Thompson, 2005; Murphy, Mazzocco, Hanich, & Early, 2007) contribute to a thorough understanding of mathematics readiness in the absence of specific empirical research dedicated to mathematics readiness. Along with the scarceness of research on mathematics readiness is a corresponding rarity of mathematics assessments for use by early elementary teachers. For example, the mathematics assessment *KeyMath* (Connolly, 1971, 1976, 1988, 1998, 2007), for use with students in Kindergarten through ninth grade, is available for exclusive use by resource teachers and school psychologists in the Halifax Regional School Board, but is not available to classroom teachers (though this is not reflective of all other school boards in Nova Scotia). *PRIME* materials (Small, 2004-2007) are available to teachers who have participated in a 3-day training session, but the "Diagnostic Tools" proposed there are not normed, nor are they intended to diagnose academic achievement or deficit beyond guiding the teacher to the appropriate resources in any given mathematics strand kit. While there does not seem to be an available and suitable mathematics readiness assessment and monitoring tool for mathematics, there is a popular (Ross, 2004) literacy readiness and achievement instrument, *An Observational Survey of Early Literacy Achievement*, (Clay M. M., 1995) available for teachers' use--though its empirical research is questioned by many critics (Fawson, Reutzel, Smith, Ludlow, & Sudweeks, 2006; Ross, 2004; Center, Wheldall, & Freeman, 1992; Nicholson, 1989; Iverson & Tunmer, 1993). Results of this study indicate that all of participating Kindergarten teachers use some or all of the components of Marie Clay's *An Observational Survey of Early Literacy Achievement*, including "Running Records" and "Concepts of Print." No participating Kindergarten teacher reported using a

standardised assessment tool for mathematics. In addition, almost half of the Kindergarten teachers reported that they do not have informal methods for assessing mathematics readiness. Informal methods that are used by some of Kindergarten teachers focused almost exclusively on numeracy, ignoring other important strands of mathematics such as geometry, measurement, data management, and probability.

In this study, I gathered specific information on Kindergarten teachers’ knowledge of incoming students’ readiness in mathematics. Current and former Kindergarten teachers reported that they are unprepared to comment on more than half of the 13 mathematics items included in the survey by the end of the first month of the academic year. In contrast, all participants reported that they were prepared to comment on every literacy item. It is possible that this is due to the fact that literacy outcomes are usually addressed holistically. More than half of current Kindergarten teachers reported that they were mostly or completely unprepared to assess 85% (11 of 13) of mathematics indicators; more than half of the current Kindergarten teachers were unprepared to comment on items referring to measurement, time and operations (see Figure 27: Kindergarten Teachers' Preparedness for Assessing Readiness).

Figure 27: Kindergarten Teachers' Preparedness for Assessing Readiness



Research indicates that teachers' confidence in a curriculum area directly affects student self-confidence in that area (Stipek, Givvin, Salmon, & MacGyvers, 2001). Results of another study indicate that teachers may misrepresent their true beliefs and practice by reporting on what they anticipate the researcher would want them to believe and to be practicing (Charlesworth, Hart, Burts, Thomasson, Mosley, & Fleege, 1993). Results from my study were expected to be reflective of teachers' true beliefs: teachers' assessments of academic achievement of their students tend to be accurate, though teachers tend to inflate their assessment of students rather than rating them below grade level (Teisl, Mazzocco, & Myers, 2001). These results are troublesome if the participants were being more optimistic about their preparedness to comment on the mathematics items. Current and former Kindergarten teachers reported that they are less prepared to comment on each child's ability to measure with non-standard units, reproduce, create, and extend patterns, demonstrate an understanding simple time concepts, show addition and subtraction situations with manipulatives, and helping to create graphs than the average literacy or mathematics item (by more than one standard deviation less than the mean for all participants). This lack of preparedness and confidence in teaching topics in these areas of mathematics could be detrimental to the students' attitudes towards mathematics.

Kindergarten Teachers Are Less Prepared to Assess Mathematics in September than Literacy.

Almost half of current Kindergarten teachers reported that they do not focus on mathematics. In contrast, every Kindergarten teacher reported focussing on literacy. School readiness research also tends to focus on literacy, with a small component dedicated to mathematics, and usually exclusively limited to numeracy (for example, Heaviside & Farris, 1993; Doherty, 1997; Human Resources and Social Development Canada, 2007b). Consistently, teachers reported an imbalance in attitude towards mathematics compared to literacy; teachers reported being more prepared for literacy instruction and assessment and teachers reported that parents expected more of an emphasis on literacy. In fact, 72 % of teachers reportedly believe that they receive more support in the area of literacy than in

mathematics. Most teachers claimed that students enter school ready to participate in learning activities for both literacy and mathematics. However, nearly half of current Kindergarten teachers do not have informal methods for assessing mathematics readiness and no Kindergarten teacher reported using a formal mathematics assessment tool. In contrast, 82% of all participants reported using the formal “Running Records” to assess and to monitor reading accuracy and fluency, and all current Kindergarten teachers reported using both “Running Records” and “Concepts of Print,” which are sub-tests of *An Observational Survey of Early Literacy Achievement* (Clay M. M., 1995). Although most teachers reported favourable perceptions of support in the area of literacy and mathematics readiness from school administration, school boards, and the provincial education department, there was a consistent and observable imbalance claiming more support for literacy readiness in comparison to mathematics readiness.

Implications for Future Research

Expanding the sample population.

Participants in the study were currently teaching in a variety of positions, from Kindergarten to Junior High. Of the 82 participants, 32 reported Kindergarten as the lowest grade they have taught, and seven reported that they were currently teaching Kindergarten. To gain further insight into the specific needs Kindergarten teachers have regarding mathematics readiness, it would be desirable to repeat this study with a greater sample of Kindergarten teachers, and in a larger number of provincial jurisdictions. Interesting trends emerged when comparing practicing and former Kindergarten teachers to all participants; for example, Kindergarten teachers preferred group-oriented learning activities for instruction (such as small group work, small group guided instruction and centres). Kindergarten teachers also reported a more balanced attitude toward how children learn. Current and former Kindergarten teachers’ reported responses reveal that they are less prepared to comment on more than

half of the mathematics items in September. These trends in perceptions need to be corroborated by results obtained from a larger and wider-ranging sample.

The future of Kindergarten mathematics curricula.

Children do not need to reach a certain developmental stage to experience the joy, or the thrill of thinking mathematically and experiencing the process of doing mathematics. We unfortunately do not give children the opportunities to engage in this type of thinking. One of the first things we should do in trying to teach a learner any mathematics is to think of different concrete situations with common essence. (These situations) have just the properties of the mathematics chosen

(Sriraman & Lesh, 2007, p. 61).

Kindergarten teachers reported that they believe children learn best by participating in developmentally appropriate activities and by constructing their own knowledge. According to the NMAP report (2008), Kindergarten curricula now need to consider bringing the mathematical concepts down to the youngest students as this is when their brains are most ready to begin conceptualizing and thinking mathematically. Teachers need to be able to assess their students' readiness for learning mathematics in order to understand each child's prior experiences, because this experiences are intimately linked to each child's development (National Mathematics Advisory Panel, 2008), and can inform teaching choices. The Kindergarten curriculum needs to tap into the joy and wonder that emerges from discovering and constructing mathematical concepts (Sriraman & English, 2004); the corresponding curriculum and assessments for readiness and achievement need to foster this joy and target the mathematical concepts (not skills) with engaging activities that are accurate and that are not compromised by the requirement of proficiency in literacy. Curriculum development and the assessments that will inform teachers' instructional planning should be creatively designed to complement one another and strengthen student success. A careful analysis of successful Kindergarten

curricula should be undertaken in order to inform which outcomes from the later grades to include at this level.

Is there a need for a standard mathematics readiness assessment tool for Kindergarten teachers?

A standard mathematics readiness assessment tool would benefit Kindergarten teachers. It is evident that a traditional standardized assessment tool would be ineffective for assessing Kindergarten students, since its reliability would be questionable; typically, such a tool relies on reading, viewing, writing and representing, and students this young have underdeveloped skills in these areas. A mathematics readiness tool would have to be conceptually based, and assess students' prior knowledge of pre-Kindergarten mathematics concepts. Given that almost half the current Kindergarten teachers indicated they do not have informal methods to assess mathematics readiness, and that none indicated the use of a standardized assessment tool, a tool would indeed be of value. Such a tool would provide Kindergarten teachers with more information about their students' prior knowledge and prerequisite skills necessary for the achievement of Kindergarten mathematics outcomes.

Specific recommendations for the development of a standard mathematics readiness assessment tool for Kindergarten teachers.

Development and administration of early assessment tools pose particular challenges to researchers and require innovative and careful consideration in order to obtain valid and meaningful results. Rogers (2007) reports that assessment activities must be well designed, engaging, allow children to demonstrate knowledge in the specific domain being assessed, and the assessment must have sensitive diagnostic qualities. Developers of a mathematics readiness assessment tool must be cognizant that: "Most teaching and assessment in mathematics takes place in the context of reading, writing and pictures. [...] For younger children, first-hand experiences involving number are concrete, observing everyday items being handled and moved, such as toys and food items" (Rogers, 2007, p.

212). Task requirements must be clearly understood by the children, questions must be valid and evaluate the knowledge that is clearly being sought (Rogers, 2004); that is to say, literacy, fine motor skills, and social-knowledge cannot be barriers to understanding, completing or demonstrating knowledge of the mathematics readiness indicators (Doherty, 1997).

This study's survey results provide insight into the type of comprehensive and informative mathematics readiness tool that should be developed and tested in a subsequent study. Preschool teachers prefer to integrate mathematics into the everyday routines of a classroom (Lee & Ginsberg, 2007), which makes the mathematics meaningful and connected to the children's world. Kindergarten teachers reported routine and centres as the pinnacle of classroom management. The results of this study suggest that a mathematics readiness assessment tool should be designed for small group work, the preferred method of assessment by 57% of current Kindergarten teachers. It would be effective if the tool was designed for use in centres, since this approach is regularly used by 71% of current Kindergarten teachers, and is the preferred teaching method for 57% of them. It could fit seamlessly into a typical Kindergarten routine for September use. While teaching appropriate behaviour and enforcing appropriate behaviour in classroom routines such as centres and small group work, a ready-made meaningful readiness assessment could save time in the short-term and the long-term instructional planning of a Kindergarten class, as teachers would have the information they need in order to make instructional decisions. Research indicates that even a single task can provide insight into a child's numeracy proficiency (Nicol & Kelleher, 2004), and perhaps this can be extended to other strands in mathematics, such as those of measurement, geometry, data management, and probability. Targeted observation, an assessment strategy reportedly used by 100% of current Kindergarten teachers, could be a potential method for assessment; this is also successful with administration and assessment with *An Observational Survey of Early Literacy Achievement* (Clay M. M., 1995). It should be versatile enough to blend into Kindergarten centres at any point of the school year, as Kindergarten

teachers expressed concern about treating outcomes in all of the mathematics strands in the first month of school.

Conclusion to the Chapter

The results of this study have strong implications to the research field as it contributes research dedicated to early elementary mathematics readiness. This study surveyed teachers about current practices for assessing mathematics readiness. Results identified specific areas that need to be supported for improvements in the area of assessing mathematics readiness. Consistently throughout the analysis of the results, teachers reported that mathematics was less supported and less deeply treated in Kindergarten. The practical implications of the results of this survey may result in the development of a readiness tool for mathematics that would support more adequately a Kindergarten teacher' daily or weekly instructional planning, and this would have an immediate effect on Kindergarten student achievement with more precise and tailored instruction.

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Appendix A: NS Kindergarten Mathematics Curriculum Outcomes and Necessary Prior Knowledge

Table 16: Nova Scotia Kindergarten Mathematics Curriculum Outcomes and Corresponding Necessary Prior Knowledge

Atlantic Canada Kindergarten Mathematics Outcomes ¹ (based on NCTM)	Previous Experience Necessary to Achieve the Outcome (Determined by the Researcher)
Number Sense and Number Concepts	
A1 sort sets on the basis of number	Sorting items based on other attributes (like colour/shape/size)
A2 count to determine the number in a group	Experience with the number order (counting out loud) Number names One-to-one correspondence
A3 create sets of a given number	Experience with sets of items Experience with quantities One-to-one correspondence
A4 explore a variety of physical representations of numbers	Experience with groups of numbers organized in a countable way (like dice)
A5 count in a variety of ways	Counting in order and forward
A6 interpret ordinal numbers	Experience with language
A7 recognize the meaning of halves when used in context	Experience with the concept of a whole
A8 use symbols to represent number	Experience seeing and interpreting symbols for numbers
A9 determine which group has more, which has less/fewer, or whether groups are equivalent	Experience with quantity continuity Experience with comparing objects and sets to spot differences One-to one correspondence
Operation Sense and Number Operations	
B1 count the results when small groups are combined	One-to-one correspondence The concept of combining
B2 count the results when small groups are separated	One-to-one correspondence The concept of separating
B3 determine how many more one group has than another	One-to-one correspondence The concept of comparing

¹ (Nova Scotia Department of Education and Culture, 1998)

Appendix B: Developmentally Appropriate Practice- Learning Paths and Teaching Strategies in Early Mathematics




Figure 28: NAEYC and NCTM Learning Paths and Teaching Strategies in Early Mathematics

Learning Paths and Teaching Strategies in Early Mathematics

Examples of typical achievements of 3- to 6-year-olds and teaching strategies to promote them

The research base for sketching a picture of children’s mathematical development varies considerably from one area of mathematics to another. Outlining a learning path, moreover, does not mean we can predict with confidence where a child of a given age will be in that sequence. Developmental variation is the norm, not the exception. However, children do tend to follow similar *sequences*, or *learning paths*, as they develop. This chart illustrates in each area some things that

many children know and do—early and late in the 3–6 age range. These are, then, simply two points along the learning path that may have many steps in between. For each content area, the Sample Teaching Strategies column shows a few of the many teacher actions that promote learning, when used within a classroom context that reflects the recommendations set forth in this position statement. In general, they are helpful strategies, with minor adaptations, across the age range.

Content Area	Examples of typical knowledge and skills		Sample Teaching Strategies
	From Age 3	Age 6	
Number and Operation	Counts a collection of 1–4 items and begins to understand that the last counting word tells “how many.”	Counts and produces (counts out) collections up to 100 using groups of 10.	Models counting of small collections and guides children’s counting in everyday situations, emphasizing that we use one counting word for each object:  “one . . . two . . . three . . .” Models counting by 10s while making groups of 10s (e.g., 10, 20, 30 . . . or 14, 24, 34 . . .).
	Quickly “sees” and labels collections of 1–3 with a number.	Quickly “sees” and labels with the correct number “patterned” collections (e.g., dominoes) and unpatterned collections of up to about 6 items.	Gives children a brief glimpse (a couple of seconds) of a small collection of items and asks how many there are.
	Adds and subtracts nonverbally when numbers are very low. For example, when one ball and then another are put into the box, expects the box to contain two balls.	Adds or subtracts using counting-based strategies such as counting on (adding 3 to 5, says “five . . . , six, seven, eight”), when numbers and totals do not go beyond 10.	Tells real-life stories involving numbers and a problem. Asks “how many” questions (e.g., <i>How many are left? How many are there now? How many did they start with? How many were added?</i>). Shows children the use of objects, fingers, counting on, guessing, and checking to solve problems.
Geometry and Spatial	Begins to match and name 2-D and 3-D shapes, first only with same size and orientation, then shapes that differ in size and orientation (e.g., a large triangle sitting on its point with a small one sitting on its side).	Recognizes and names a variety of 2-D and 3-D shapes (e.g., quadrilaterals, trapezoids, rhombi, hexagons, spheres, cubes) in any orientation. Describes basic features of shapes (e.g., number of sides or angles).	Introduces and labels a wide variety of shapes (e.g., skinny triangles, fat rectangles, prisms) that are in a variety of positions (e.g., a square or a triangle standing on a corner, a cylinder “standing up” or horizontal). Involves children in constructing shapes and talking about their features.
	Uses shapes, separately, to create a picture.  Describes object locations with spatial words such as <i>under</i> and <i>behind</i> and builds simple but meaningful “maps” with toys such as houses, cars, and trees.	Makes a picture by combining shapes.  Builds, draws, or follows simple maps of familiar places, such as the classroom or playground.	Encourages children to make pictures or models of familiar objects using shape blocks, paper shapes, or other materials. Encourages children to make and talk about models with blocks and toys. Challenges children to mark a path from a table to the wastebasket with masking tape, then draw a map of the path, adding pictures of objects appearing along the path, such as a table or easel.

<p>Measurement</p>	<p>Recognizes and labels measurable attributes of objects (<i>I need a long string; Is this heavy?</i>).</p> <p>Begins to compare and sort according to these attributes (more/less, heavy/light; <i>This block is too short to be the bridge</i>).</p>	<p>Tries out various processes and units for measurement and begins to notice different results of one method or another (for example, what happens when we <i>don't</i> use a standard unit).</p> <p>Makes use of nonstandard measuring tools or uses conventional tools such as a cup or ruler as nonstandard ways (e.g., <i>It's three rulers long</i>).</p>	<p>Uses comparing words to model and discuss measuring (<i>This book feels heavier than that block I wonder if this block tower is taller than the desk</i>).</p> <p>Uses and creates situations that draw children's attention to the problem of measuring something with two different units (e.g., making garden rows "four shoes" apart, first using a teacher's shoe and then a child's shoe).</p>
<p>Pattern/Algebra</p>	<p>Notices and copies simple repeating patterns, such as a wall of blocks with long, short, long, short, long, short, long. . . .</p>	<p>Notices and discusses patterns in arithmetic (e.g., adding 1 to any number results in the next "counting number").</p>	<p>Encourages, models, and discusses patterns (e.g., <i>What's missing? Why do you think that is a pattern? I need a blue next</i>). Engages children in finding color and shape patterns in the environment, number patterns on calendars and charts (e.g., with the numerals 1–100), patterns in arithmetic (e.g., recognizing that when zero is added to a number, the sum is always that number).</p>
<p>Displaying and Analyzing Data</p>	<p>Sorts objects and counts and compares the groups formed.</p> <p>Helps to make simple graphs (e.g., a pictograph formed as each child places her own photo in the row indicating her preferred treat—pretzels or crackers).</p>	<p>Organizes and displays data through simple numerical representations such as bar graphs and counts the number in each group.</p>	<p>Invites children to sort and organize collected materials by color, size, shape, etc. Asks them to compare groups to find which group has the most.</p> <p>Uses "not" language to help children analyze their data (e.g., <i>All of these things are red and these things are NOT red</i>).</p> <p>Works with children to make simple numerical summaries such as tables and bar graphs, comparing parts of the data.</p>

Source: NAEYC and NCTM. (2002). *Early Childhood Mathematics: Promoting Good Beginnings*. Retrieved 04 26, 2009, from National Association for the Education of Young Children: <http://www.naeyc.org/about/positions/pdf/psmath.pdf>. pp. 27-29.

Appendix C: Influential Thinkers and Their Theories on Mathematics Readiness and Learning

Figure 29: Influential Thinkers on Mathematics Readiness and Learning

Piaget's

Conservation of Number Theory

- developmental
- age thresholds are provided for each stage
- the theory emphasises that time is necessary for duration and sequence
- sequential and age-dependent

Gardner's

Theory of Multiple Intelligences' Developmental Trajectory

- natural
- individuals have strengths in one or more intelligence, and learn best in those ways
- the intelligences may or may not overlap
- four-stage developmental trajectory for learning is highly developmental
- not sequential nor age-dependent

Dienes'

Six-stage Theory of Learning Mathematics

- meaningful experiences
- collaborative group work
- concepts can be introduced through play without waiting for developmental readiness
- individuals review the stages when new concepts are the introduced and the stages are not linked to age
- sequential, not age-dependent

Vygotsky's

Zone of Proximal Development

- ZPD = the difference between what a learner can do on his or her own and with help
- argument against standardized tests, as test measure what a child can do but ZPD will assess the child's ability to problem solve individually and with support
- educational researchers also use the term scaffolding, though Vygotsky never used the term himself

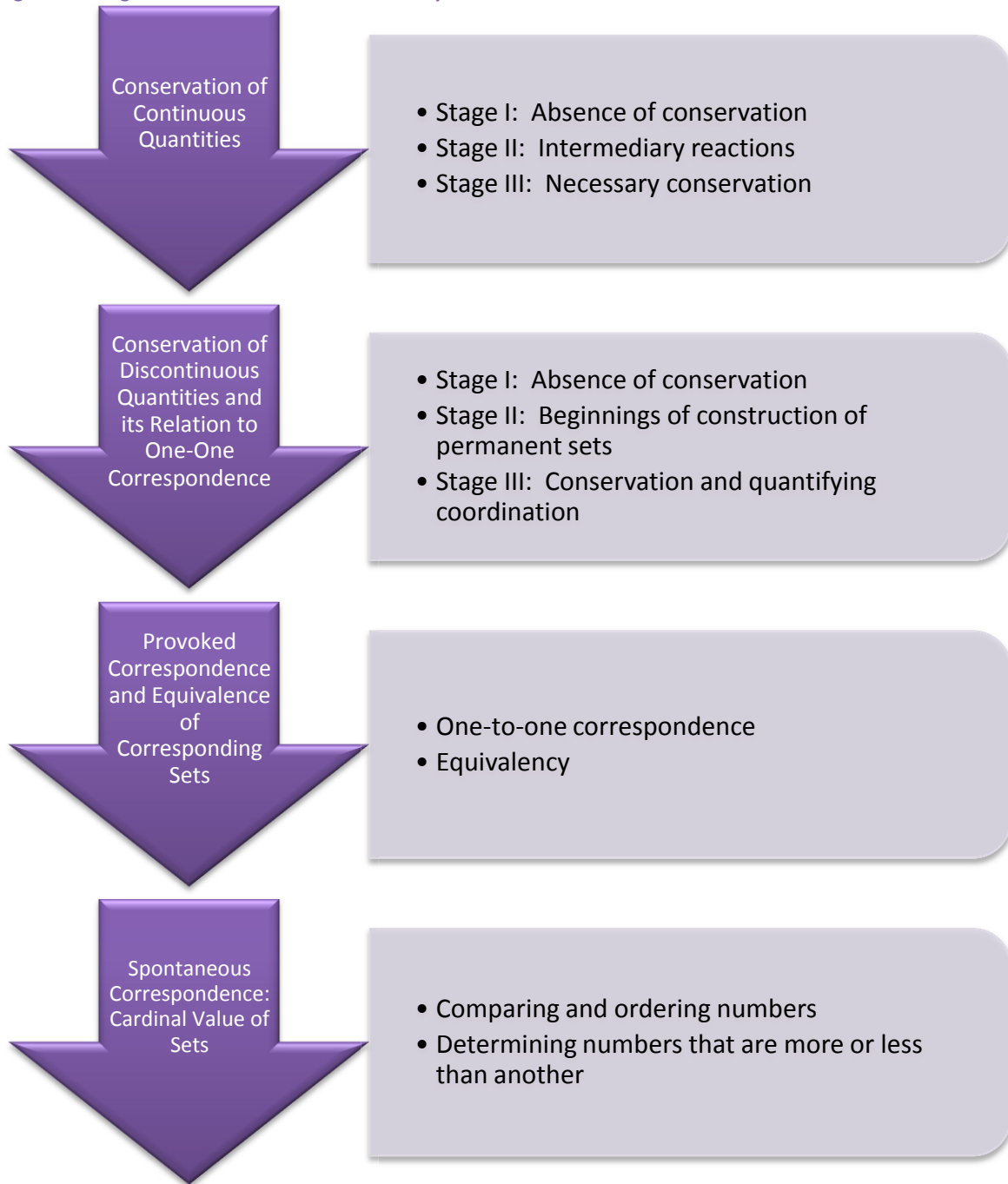
van Hiele's

Levels of (Geometric) Thinking

- learner cannot achieve a level without passing through the preceeding levels
- teacher creates meaningful experiences for the student to achieve higher levels of thinking
- sequential, but not age-dependent

Appendix D: Piaget's Conservation of Number

Figure 30: Piaget's Conservation of Number Theory²



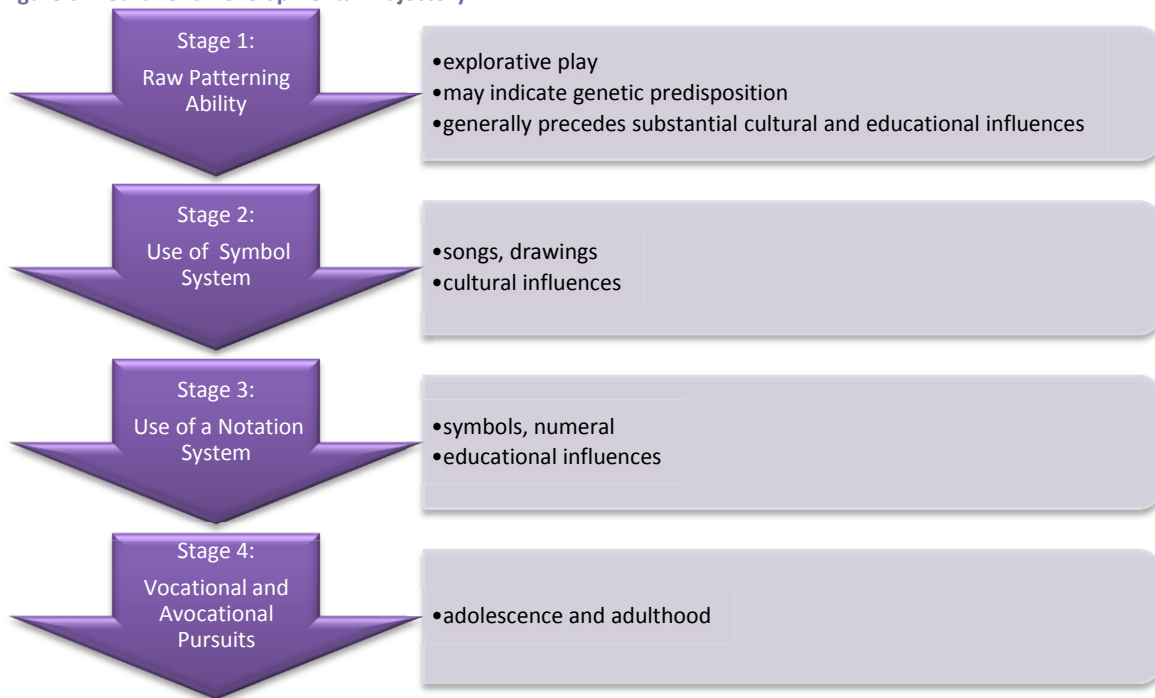
² (Piaget, 1952)

Appendix E: Gardner's Theory of Multiple Intelligences and his Developmental Trajectory

Figure 31: Gardner's Multiple Intelligences³



Figure 32: Gardner's Developmental Trajectory⁴

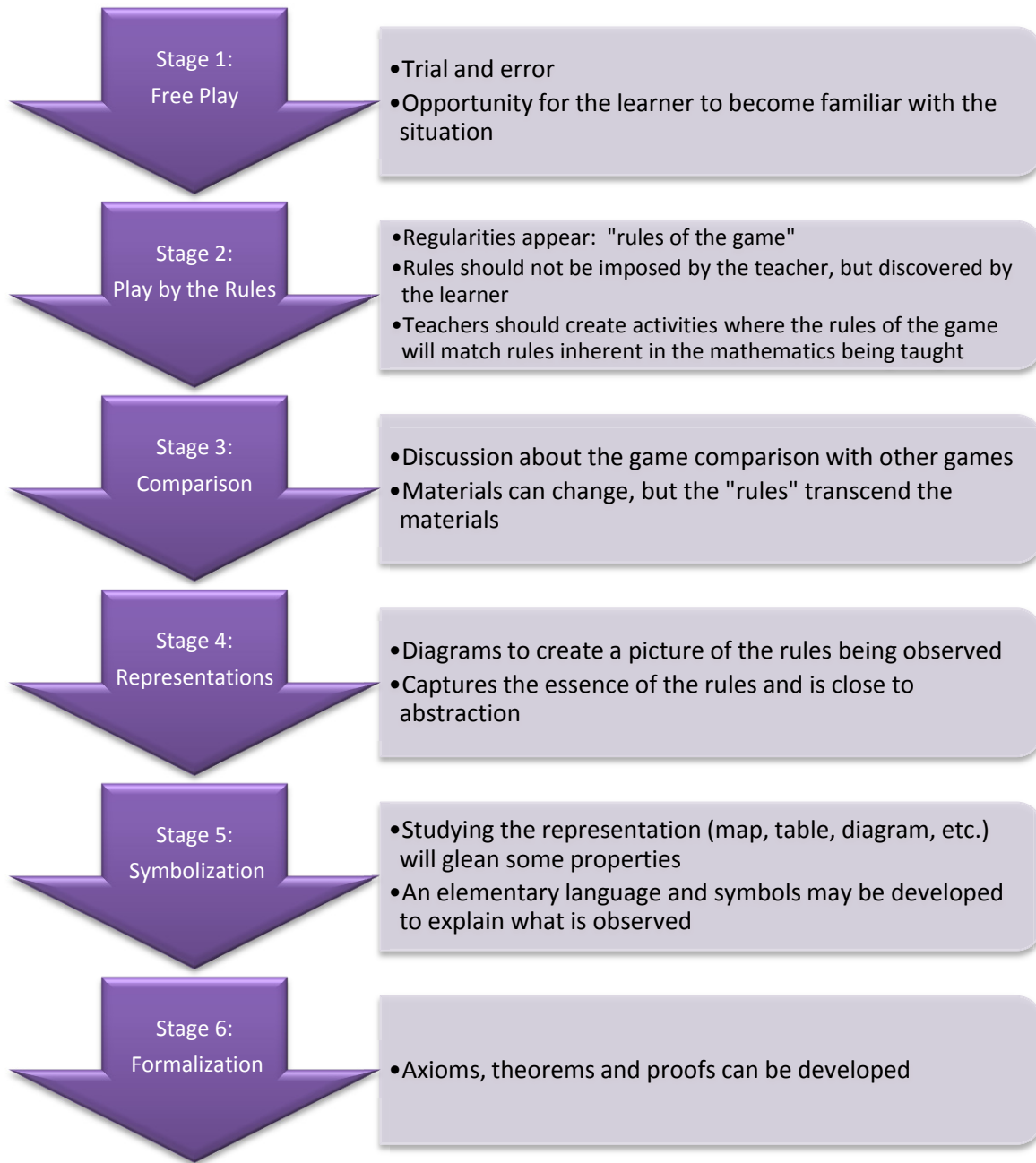


³ (Gardner, 1983)

⁴ (Gardner, 1999)

Appendix F: Dienes's Six Stage Theory of Learning Mathematics

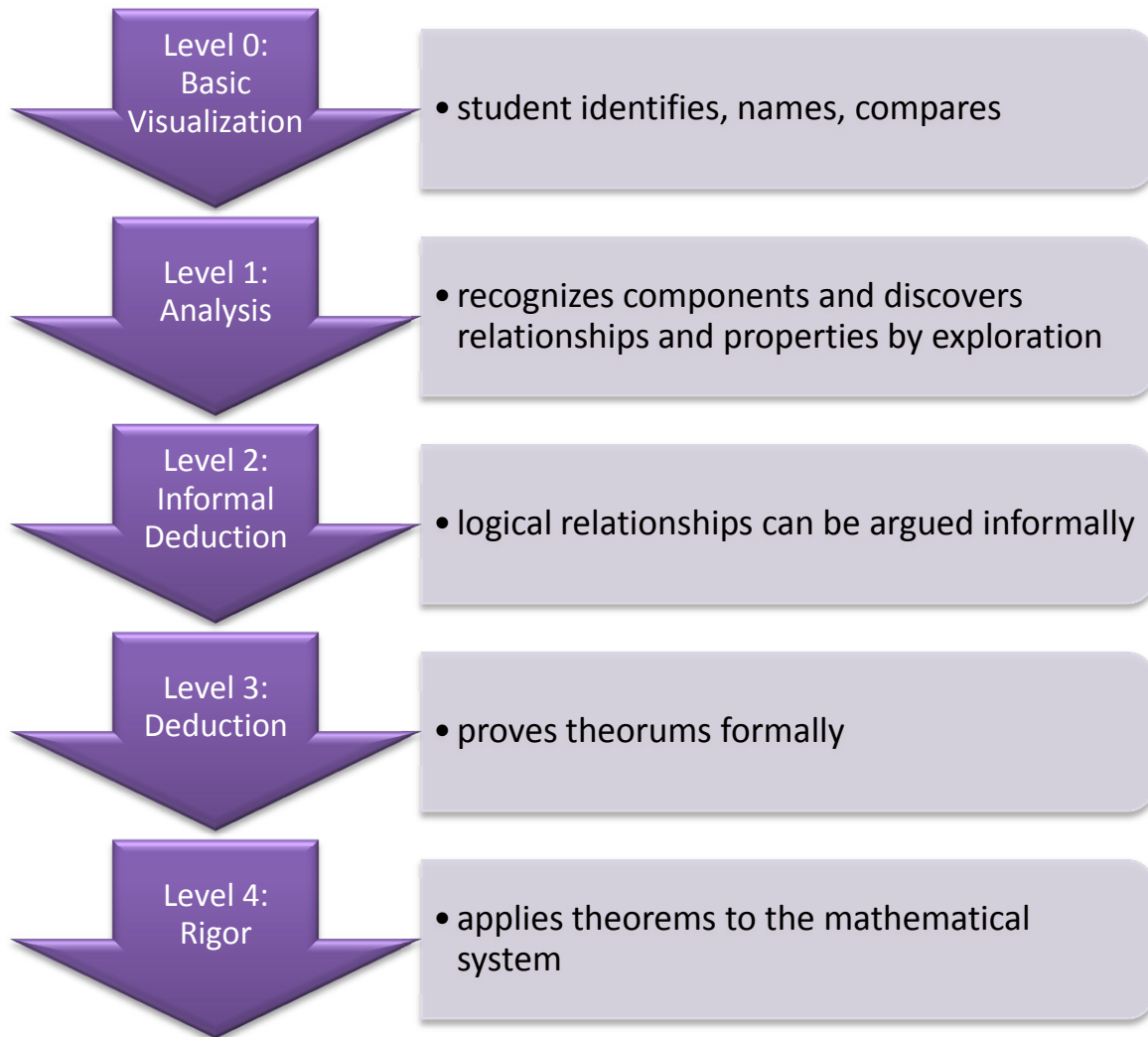
Figure 33: Dienes's Six-Stage Theory of Learning Mathematics⁵



⁵ (Dienes, Brief notes on Zoltan Dienes' six-stage theory of learning mathematics, 2008)

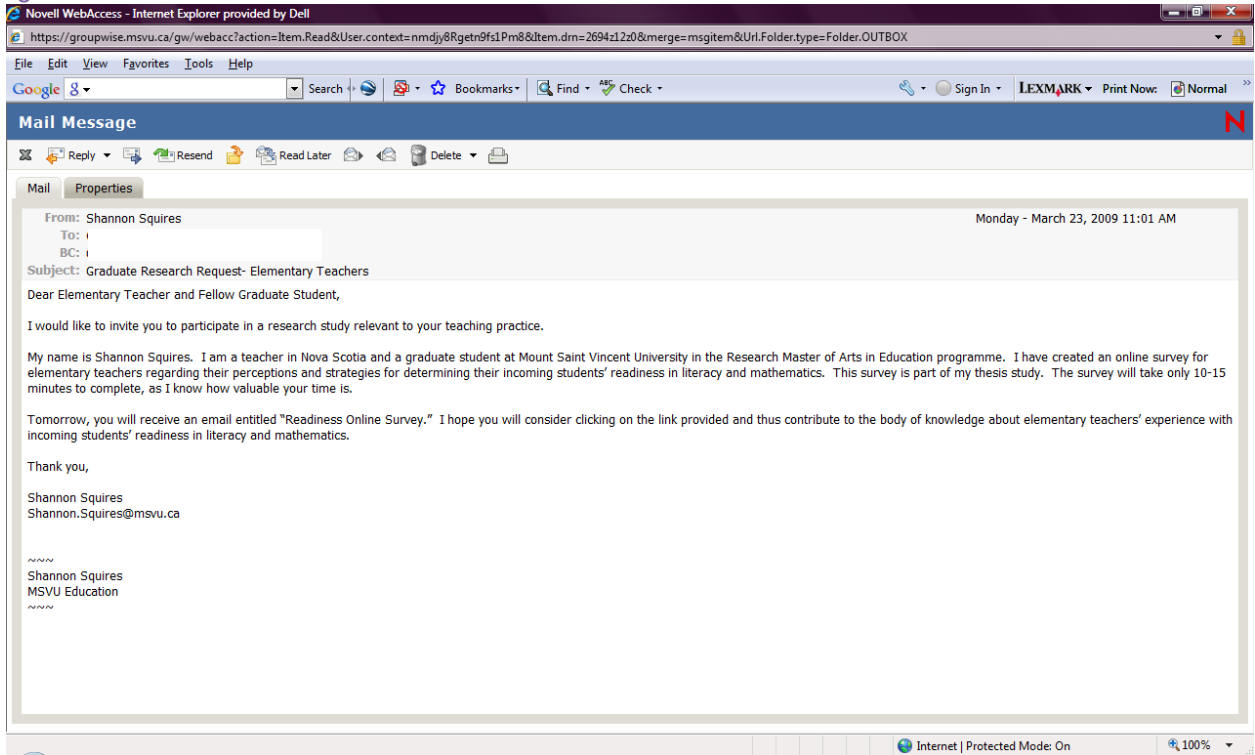
Appendix G: Van Heiles' Levels of Geometric Thinking

Figure 34: Van Heile Levels of (Geometric) Thinking



Appendix H: Participants' Package- Pre-Recruitment Email

Figure 35: Pre-Recruitment Email as Seen Online



[This email was sent to eligible participants. This email informs potential participants about the study, and primed them to participate in the study when the recruitment email was sent one day later.]

Dear Kindergarten Teacher,

I would like to invite you to participate in an exciting research opportunity!

My name is Shannon Squires. I am a Kindergarten teacher in Nova Scotia and a graduate student at Mount Saint Vincent University in the Research Master of Arts in Education programme. I have created an online survey for Kindergarten teachers on their beliefs and perceptions of incoming students' readiness in literacy and mathematics. This survey is part of my thesis study. The survey will take only 15 minutes to complete, as I know how valuable your time is.

In two days, you will receive an email entitled "Readiness Online Survey." I hope you will consider clicking on the link to help a fellow Kindergarten teacher with valuable research for the grade which we teach.

Thank you,

Shannon Squires

Shannon.Squires@msvu.ca

Appendix I: Participants' Package- Recruitment Email

Figure 36: Recruitment Email as Seen Online

Novell WebAccess - Internet Explorer provided by Dell
 https://groupwise.msvu.ca/gw/webacc?action=Item.Read&User.context=nmdjy8Rgetn9fs1Pm8&Item.drm=2710:z0&merge=msgitem&Url.Folder.type=Folder.OUTBOX

File Edit View Favorites Tools Help
 Google Search Bookmarks Find Check Sign In LEXMARK Print Now Normal

Mail Message

Reply Resend Read Later Delete

Mail Properties

From: Shannon Squires
 To:
 BC:
 Subject: Readiness Online Survey
 Tuesday - March 24, 2009 9:30 AM

Please go to this web address to complete the study: www.msvu.ca/education/survey/

Dear Elementary Teacher and Fellow Graduate Student:

My name is Shannon Squires and I am a teacher in Nova Scotia and a graduate student at Mount Saint Vincent University in the Research Master of Arts in Education programme. I am collecting data for my thesis on readiness for a Research Master of Arts degree at Mount Saint Vincent University. My supervisor for this project is Dr. Geneviève Boulet.

I am hopeful that as fellow elementary teacher and graduate student, you will be willing to take a short amount of your time to participate in this study. The study will compare teacher's perceptions and assessment of literacy readiness and mathematics readiness in elementary students. I have obtained ethical approval from Mount Saint Vincent University Research Ethics Board.

The survey will take approximately 10-15 minutes to complete. If you are interested in participating in this study, follow the link to the survey, read the Informed Consent Form, and proceed to the online survey: www.msvu.ca/education/survey/. This link will be active for 10 days from today. A follow-up reminder email will be sent in one week.

If you are interested in receiving results from this research study once it is completed, please send an email to Shannon.Squires@msvu.ca, and indicate "Request for Research Results" in the subject line. This can be done at any time. Research results will be emailed in the Spring of 2009 to those participants who make the request.

Information collected by the online survey will be analysed and results will be used in my thesis. No individual survey results will be included, and anonymity is assured. There are no identifying questions on the survey, and any requests for research results are completely separate from the online survey. Only my supervisor, Dr. Boulet, and I will have access to the electronic survey data. The survey results will be encrypted and electronic data files are password protected.

Your participation is voluntary, and you may withdraw from this study at any time.

Please go to this web address to complete the study: www.msvu.ca/education/survey/

If you have any questions about this study, please contact me or my supervisor at your convenience.

Shannon Squires
 Researcher
Shannon.Squires@msvu.ca

Dr. Geneviève Boulet, PhD
 Supervisor, MSVU
Genevieve.Boulet@msvu.ca

If you have questions about how this study is being conducted and wish to speak with someone who is not directly involved in the study, you may contact the Chair of the University Research Ethics Board (UREB) c/o MSVU Research and International Office, at 457-6350 or via e-mail at research@msvu.ca.

Please go to this web address to complete the study: www.msvu.ca/education/survey/

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[This email was sent to eligible participants. This email invited potential recruits to participate in the study.]

Readiness Online Survey *(this will be an active link)*

Dear Kindergarten Teacher:

My name is Shannon Squires and I am a Kindergarten teacher in Nova Scotia and a graduate student at Mount Saint Vincent University in the Research Master of Arts in Education programme. I am collecting data for my thesis on Kindergarten readiness for a Research Master of Arts degree at Mount Saint Vincent University. My supervisor for this project is Dr. Geneviève Boulet.

The study will compare teacher's perceptions of literacy readiness and mathematics readiness in Kindergarten students. This study has passed ethical reviews at the university and your school board.

I am hopeful that as fellow Kindergarten teacher, you will be willing to take a short amount of time to participate in this study.

This online survey is being sent to Kindergarten teachers in the _____ School Board. The survey will take approximately 15 minutes to complete. If you are interested in participating in this study, follow the link to the survey, read the Informed Consent Form, and proceed to the online survey: *insert link here*. This link will be active for ten days from today.

If you are interested in receiving results from this research study once it is completed, please reply to this email and indicate "Request for Research Results" in the subject line. This can be done at any time. Research results will be emailed to those participants who make the request in the Spring of 2009.

Information collected will be analysed and results will be used in my thesis. No individual survey results will be included, and anonymity is assured. There are no identifying questions on the survey, and any requests for research results are completely separate from the online survey. Only my supervisor, Dr. Boulet, and I will have access to the survey data. The survey results will be encrypted and electronic data files are password protected.

Follow-up reminder emails will be sent within 14 days.

Your participation is voluntary, and you may withdraw from this study at any time.

If you have any questions about this study, please contact the researcher or supervisor at your convenience.

Shannon Squires
Researcher
Shannon.Squires@msvu.ca

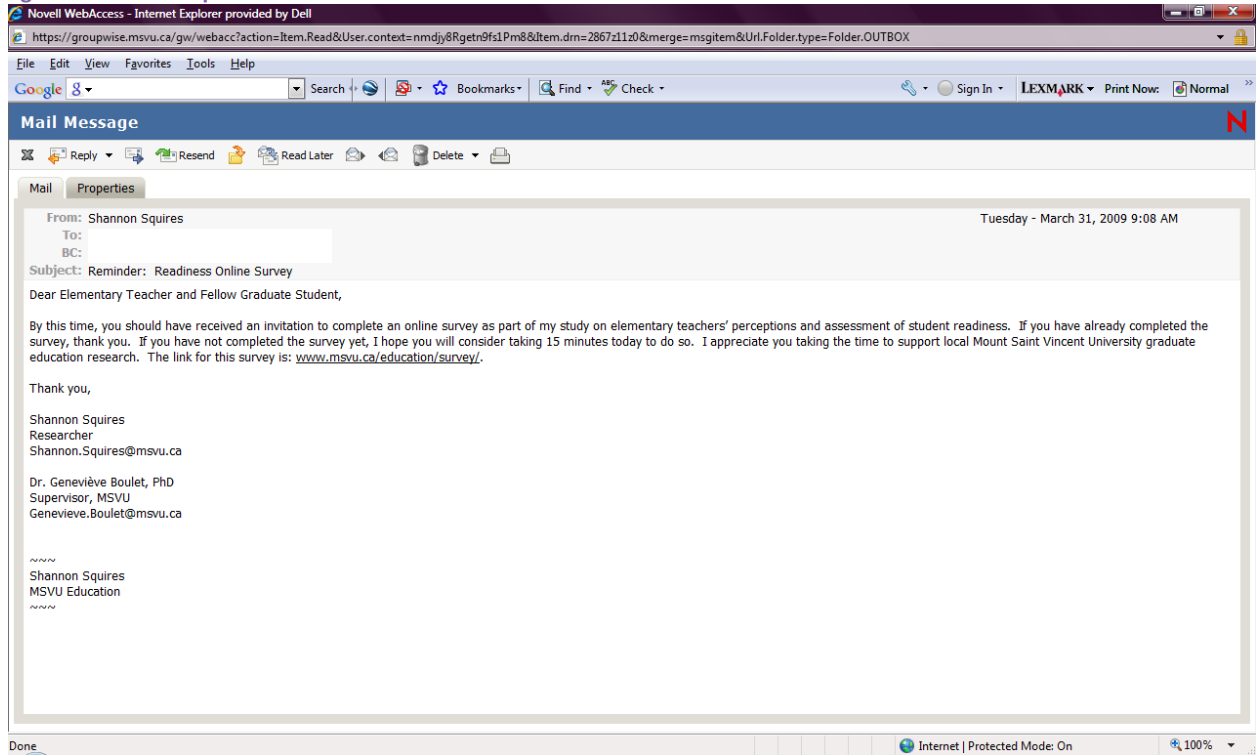
Dr. Geneviève Boulet, PhD
Supervisor, MSVU
Genevieve.Boulet@msvu.ca

If you have questions about how this study is being conducted and wish to speak with someone who is not directly involved in the study, you may contact the Chair of the University Research Ethics Board (UREB) c/o MSVU Research and International Office, at 457-6350 or via e-mail at research@msvu.ca

Please click here to complete the study: **Readiness Online Survey** *(this will be another active link)*

Appendix J: Participants' Package-Follow-Up Email

Figure 37: Follow-Up Email as Seen Online



[This email was sent to eligible participants. This email reminded and invited potential recruits to participate in the study.]

Dear Kindergarten Teacher,

By this time, you should have received an invitation to complete an online survey as part of my study on Kindergarten teachers' perceptions of student readiness. If you have already completed the survey, thank you. If you have not completed the survey yet, I hope you will consider taking 15 minutes today to do so. The link for this survey is: *insert link here*.

Thank you,

Shannon Squires
Researcher
Shannon.Squires@msvu.ca

Geneviève Boulet
Supervisor
Genevieve.Boulet@msvu.ca

Appendix K: Participants' Package- Introduction Webpage with Informed Consent

Figure 38: Elementary Readiness Survey- Informed Consent as Seen Online

The screenshot shows a web browser window displaying the 'Elementary Readiness Survey - Informed Consent' page. The page header includes the Mount Saint Vincent University logo and navigation links. The main content area is titled 'Elementary Readiness Survey' and contains the following sections:

- Elementary Readiness Survey - Informed Consent (pdf)**
- Informed Consent**: Thank you for agreeing to participate in this study on Teacher's Perceptions of Elementary Students' Readiness for Learning.
 - You are eligible to complete this survey if you are an **Elementary** teacher.
 - This online survey will take approximately 15 minutes.
- Researcher**: Shannon Squires under the supervision of Dr. Geneviève Boulet. Shannon Squires is a graduate student at Mount Saint Vincent University in the Research Master of Arts Programme. Dr. Geneviève Boulet is a professor in the Faculty of Education at Mount Saint Vincent University. Contact information for both the researcher and supervisor are found at the end of this page and in your recruitment email.
- Goal of this Study**: I am interested in learning about your perceptions and assessment of incoming students' readiness in literacy and in mathematics.
- Participation**:
 - Time: 15 minutes
 - Procedure: respond to an online survey

Most questions in this short survey will ask you to select the answer that best describes your belief or perception. A few questions are open-ended and will require you to type your answer in a form box.
- Protection of Participants**: Participation is voluntary. You may decline to participate or skip any questions you are not comfortable answering. Your responses are confidential and anonymous. Responses are entered into an Excel database. No question asks for identifying information. At no time will I be able to identify you. This ensures your anonymity.
- Risks**: Risks are minimal. The risks in participating in this study are minimal and are related to using a computer. Some people experience slight eye strain when using a computer monitor. Some people experience soreness in their wrists or fingers.
- Contact Information**:
 - If you have any questions about this study, please contact:
 - Researcher, Shannon Squires: Shannon.Squires@msvu.ca
 - Supervisor, Geneviève Boulet: Genevieve.Boulet@msvu.ca
 - If you have questions about how this study is being conducted and wish to speak with someone who is not directly involved in the study, you may contact the Chair of the University Research Ethics Board (UREB) c/o MSVU Research and International Office, at 457-6350 or via e-mail at research@msvu.ca.
- Action**: Please click on the button below to indicate your consent to participate in the study and proceed to the short online survey. Your participation is voluntary, and you may withdraw from the study at any time. A button labeled 'I agree to participate in this study.' is visible.

The footer contains the text: 'S-4-09 100 Bedford Highway, Halifax, N.S., B3M 2J6, (902) 457-6117, admissions@msvu.ca Disclaimer'.

[A button reading “**I agree to participate in this study**” is at the bottom of the online Informed Consent Page, and leads participants to the online survey. This letter can be downloaded as an Adobe Acrobat file and printed by clicking on the link at the top of the webpage.]



Kindergarten Readiness Survey

Informed Consent

Thank you for agreeing to participate in this study on Teacher’s Perceptions of Kindergarten Students’ Readiness for Learning.

- You are eligible to complete this survey if you are a **Kindergarten** teacher.
- This online survey will take approximately 15 minutes.

Researcher

Shannon Squires under the supervision of Dr. Geneviève Boulet.

Shannon Squires is a graduate student at Mount Saint Vincent University in the Research Master of Arts Programme. Dr. Genevieve Boulet is a professor in the Faculty of Education at Mount Saint Vincent University. Contact Information for both the researcher and supervisor are found at the end of this page and in your recruitment email.

Goal of this Study

I am interested in learning about your perceptions and assessment of incoming students’ readiness in literacy and in mathematics.

Participation

Time: 15 minutes

Procedure: respond to an online survey

Most questions in this short survey will ask you to select the answer that best describes your belief or perception. A few questions are open-ended and will require you to type your answer in a form box.

Protection of Participants

Participation is voluntary. You may decline to participate or skip any questions you are not comfortable answering. Your responses are confidential and anonymous.

Responses are entered into an Excel database. No question asks for identifying information. At no time will I be able to identify you. This ensures your anonymity.

Risks

Risks are minimal.

The risks in participating in this study are minimal and are related to using a computer. Some people experience slight eye strain when using a computer monitor. Some people experience soreness in their wrists or fingers.

If you have any questions about this study, please contact:

Shannon Squires
Researcher
Shannon.Squires@msvu.ca

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Supervisor
Genevieve.Boulet@msvu.ca

If you have questions about how this study is being conducted and wish to speak with someone who is not directly involved in the study, you may contact the Chair of the University Research Ethics Board (UREB) c/o MSVU Research and International Office, at 457-6350 or via e-mail at research@msvu.ca.

Appendix L: Readiness and Assessment in Early Elementary Survey for Kindergarten Teachers

Figure 39: Readiness and Assessment in Elementary Survey for Elementary Teachers as Seen Online

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Visitors | Potential Students | Current Students | Faculty & Staff | Alumnae & Friends

Readiness and Assessment in Elementary Survey for Elementary Teachers

Education Directory

Introduction

1. What elementary grade level do you currently teach?
 Other

2. What is the LOWEST elementary grade level you have taught?

Teaching and Learning - Section 1/6

1. How do you believe children learn best? (Please select all that apply.)

<input type="checkbox"/> Children learn by constructing their own knowledge.	<input type="checkbox"/> Children learn by building on their prior knowledge.
<input type="checkbox"/> Children learn by practicing skills.	<input type="checkbox"/> Children learn by participating in developmentally appropriate activities.
<input type="checkbox"/> Children learn by working on concepts with skills that are challenging but not frustrating.	<input type="checkbox"/> Children learn by developing individual learning styles.

2. Of the beliefs selected above, which do you believe is MOST important?

3. Which of the following methods do you use regularly- at least once each typical school day- to teach students? (Please select all that apply.)

<input type="checkbox"/> Whole class instruction	<input type="checkbox"/> Conferring one-on-one
<input type="checkbox"/> Small group work	<input type="checkbox"/> Centres
<input type="checkbox"/> Worksheets	<input type="checkbox"/> Workbooks
<input type="checkbox"/> Small group targeted instruction (i.e. guided reading)	<input type="checkbox"/> Peer-teaching (including buddies from another grade)

4. Of the methods selected above, which do you use MOST during a single typical teaching day?

Beliefs and Practice - Section 2/6

For the following questions, please select the descriptor that best describes your attitude toward each statement in regards to your belief or practice.

	Completely disagree	Mostly disagree	Mostly agree	Completely agree
1. In my classroom, I focus mostly on literacy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. In my classroom, I focus mostly on mathematics.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I believe I am prepared for literacy instruction and assessment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I believe I am prepared for mathematics instruction and assessment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. The parents of my students expect an emphasis on literacy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. The parents of my students expect an emphasis on mathematics.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. I believe there is more support in the area of literacy than mathematics for teachers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. I believe there is more support in the area of mathematics than literacy for teachers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Additional Comments:

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Readiness - Section 3/6

1. Please rank the following descriptors in the order of influence on a child's readiness for school (1 being most influential, followed by 2, 3, 4, 5...):

- Age (birth date)
- Prior experiences
- Parental involvement
- Genetics
- Pre-school attendance
- Other

For the following questions, please select the descriptor that best describes your attitude toward each statement in regards to your belief or practice.

	Completely disagree	Mostly disagree	Mostly agree	Completely agree
2. The children who enter my class in September are ready to participate in learning activities around reading and writing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. The children who enter my class in September are ready to participate in learning activities around mathematics.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I have informal methods for assessing my students' literacy readiness.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4b. If you answered "Completely agree" or "Mostly agree" for question 4 please describe informal methods you use for assessing literacy readiness below:				
<input style="width: 100%;" type="text"/>				
5. I have informal methods for assessing my students' mathematics readiness.				
5b. If you answered "Completely agree" or "Mostly agree" for question 5 please describe informal methods you use for assessing mathematics readiness below:				
<input style="width: 100%;" type="text"/>				

Assessment - Section 4/6

1. Please indicate which of the following standardized assessments you use with your students: (Select all that apply.)

<input type="checkbox"/> Marie Clay's An Observational Survey	<input type="checkbox"/> Running Records
<input type="checkbox"/> Concepts of Print	<input type="checkbox"/> Sight word lists
<input type="checkbox"/> Prime math assessments	<input type="checkbox"/> KeyMath
<input type="checkbox"/> Other	
If you have selected "Other," please indicate other standardized assessments you use with your kindergarten students:	
<input style="width: 100%;" type="text"/>	

2. Please indicate the types of assessments you use with your students: (Select all that apply.)

<input type="checkbox"/> Observation	<input type="checkbox"/> Checklists
<input type="checkbox"/> Written samples (i.e. worksheets, tests, journals)	<input type="checkbox"/> One-on-one conferencing
<input type="checkbox"/> Other	<input type="checkbox"/> Self-reflections
If you have selected "Other," please indicate other types of assessments you use with your kindergarten students:	
<input style="width: 100%;" type="text"/>	

3. How frequently do you assess your students for instructional planning?

Select Answer

4. Considering classroom and time management issues, which type of assessments do you prefer?

Select Answer

5. How do you organize your classroom to create time to assess your students?

Preparedness - Section 5/6

Please recall the lowest grade level class you have ever taught for this section. Imagine it is one month into the school year with your class. Please indicate how prepared you would be to evaluate each of the following skills or concepts based on assessments (including observation) that you would have done only within the month of **September**. This does not mean that the students will have achieved all these skills or concepts, but rather that you would have an informed assessment of the child's current ability.

Recall the lowest grade level you have ever taught: At the end of September, consider how prepared would you be to comment on each child's ability to...

	Completely unprepared	Mostly unprepared	Mostly prepared	Completely prepared
1. Read his or her own name	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Print his or her own name	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Identify letters in his or her own name	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Identify all the letters in the alphabet (out of order)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Make corresponding sounds for all the letter in the alphabet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. Name a word that begins with each letter in the alphabet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Attempt to write words	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Use words and pictures to convey meaning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. Read a simple picture book	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Demonstrate concepts of print	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. Listen to a story	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. Follow directions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. Speak aloud	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Additional comments on preparedness for commenting on each child's **literacy** abilities in September:

Recall the lowest grade level you have ever taught: At the end of September, consider how prepared would you be to comment on each child's ability to...

	Completely unprepared	Mostly unprepared	Mostly prepared	Completely prepared
14. Count to 10	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. Print the numerals 0-9	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16. Identify numerals 0-9 (out of order)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17. Order numbers 0-10	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18. Identify shapes (circle, square, triangle, rectangle, oval, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19. Measure with non-standard unit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. Reproduce patterns	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21. Create patterns	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22. Extend patterns	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23. Demonstrate an understanding of broad time concepts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24. Show addition situations (with manipulatives)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25. Show subtraction situations (with manipulatives)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
26. Help to create graphs based on likes/dislikes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Additional comments on preparedness for commenting on each child's **mathematics** abilities in September:

Support - Section 6/6

For the following questions, please select the descriptor that best describes your attitude toward each statement in regards to your belief or practice.

	Completely disagree	Mostly disagree	Mostly agree	Completely agree
1. I feel supported by my school administration in the area of literacy readiness.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I feel supported by my school board in the area of literacy readiness.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I feel supported by my provincial education department in the area of literacy readiness.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. If you answered 'Mostly Agree' or 'Completely Agree' to any question (1-3), please describe how you feel supported in the area of literacy readiness :	<input type="text"/>			
5. If you answered 'Mostly Disagree' or 'Completely Disagree' to any question (1-3), please describe how you would like to be supported in the area of literacy readiness :	<input type="text"/>			
	Completely disagree	Mostly disagree	Mostly agree	Completely agree
6. I feel supported by my school administration in the area of mathematics readiness.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. I feel supported by my school board in the area of mathematics readiness.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. I feel supported by my provincial education department in the area of mathematics readiness.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. If you answered 'Mostly Agree' or 'Completely Agree' to any question (6-8), please describe how you feel supported in the area of mathematics readiness :	<input type="text"/>			
10. If you answered 'Mostly Disagree' or 'Completely Disagree' to any question (6-8), please describe how you would like to be supported in the area of mathematics readiness :	<input type="text"/>			

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Teaching and Learning

1. How do you believe Kindergarten children learn best? (Please select all that apply.)
 - Children learn by constructing their own knowledge.
 - Children learn by building on their prior knowledge.
 - Children learn by practicing skills.
 - Children learn by participating in developmentally appropriate activities.
 - Children learn by working on concepts with skills that are challenging but not frustrating.
 - Children learn by developing individual learning styles.

2. Of the beliefs selected above, which do you believe is MOST important? *[This will appear as a drop down menu.]*

3. Which of the following methods do you use regularly- at least once each typical school day- to teach Kindergarten students? (Please select all that apply.)
 - Whole class instruction.
 - Small group targeted instruction (i.e. guided reading)
 - Small group work
 - Centres
 - Worksheets
 - Workbooks
 - Conferring one-on-one
 - Peer-teaching (including buddies from another grade)

4. Of the methods selected above, which do you use MOST during a single typical teaching day? *[This will appear as a drop down menu.]*

Beliefs and Practice

For the following questions, please select the descriptor that best describes your attitude toward each statement in regards to your belief or practice.

[Numbers corresponding to the descriptors will not appear in the online survey, dots will appear, but the descriptors will be given values for data analysis when imported to Excel.]

	Completely disagree	Mostly disagree	Mostly agree	Completely agree
9. In my classroom, I focus mostly on literacy.	1	2	3	4
10. In my classroom, I focus mostly on mathematics.	1	2	3	4
11. I believe I am prepared for literacy instruction and assessment.	1	2	3	4
12. I believe I am prepared for mathematics instruction and assessment.	1	2	3	4
13. The parents of my students expect an emphasis on literacy.	1	2	3	4
14. The parents of my students expect an emphasis on mathematics.	1	2	3	4
15. I believe there is more support in the area of literacy than mathematics for teachers.	1	2	3	4
16. I believe there is more support in the area of mathematics than literacy for teachers.	1	2	3	4

Additional comments: *[A form box will be provided for answers.]*

Readiness

1. Please rank the following descriptors in the order of influence on a child’s readiness for school (1 being most influential, followed by 2, 3, 4, 5...):

- ___ Age (birth date)
- ___ Prior experiences
- ___ Parental involvement
- ___ Genetics
- ___ Pre-school attendance
- ___ Other _____

For the following questions, please select the descriptor that best describes your attitude toward each statement in regards to your belief or practice.

[Numbers corresponding to the descriptors will not appear in the online survey, dots will appear, but the descriptors will be given values for data analysis when imported to Excel.]

	Completely disagree	Mostly disagree	Mostly agree	Completely agree
2. The children who enter my class in September are ready to participate in learning activities around reading and writing.	1	2	3	4
3. The children who enter my class in September are ready to participate in learning activities around mathematics.	1	2	3	4
4. I have informal methods for assessing my students’ literacy readiness.	1	2	3	4

4b. If you answered “**Completely agree**” or “**Mostly agree**” for question 4, please describe informal methods you use for assessing **literacy** readiness below:

[A form box will be provided for answers.]

5. I have informal methods for assessing my students’ mathematics readiness.	1	2	3	4
--	---	---	---	---

5b. If you answered “**Completely agree**” or “**Mostly agree**” for question 5, please describe informal methods you use for assessing **mathematics** readiness below:

[A form box will be provided for answers.]

Assessment

1. Please indicate which of the following standardized assessments you use with your Kindergarten students: (Select all that apply.)
- Marie Clay's *An Observational Survey*
 - Running Records
 - Concepts of Print
 - Sight word lists
 - PRIME math assessments
 - KeyMath (completed by specialist)
 - Other

If you selected "Other," please indicate other standardized assessments you use with your Kindergarten students: *[A form box will be provided for additional assessments.]*

2. Please indicate the types of assessments you use with your Kindergarten students: (Select all that apply.)
- Observation
 - Checklists
 - Written samples (i.e. worksheets, tests, journals)
 - One-on-one conferencing
 - Self-reflections
 - Others

If you selected "Other," please indicate other types of assessments you use with your Kindergarten students: *[A form box will be provided for additional assessments types.]*

3. How frequently do you assess your Kindergarten students for instructional planning?

[This will appear as a drop down menu.]

- Daily
- Weekly
- Monthly
- By term
- When I notice growth

4. Considering classroom and time management issues, which type of assessments do you prefer?

[This will appear as a drop down menu.]

- One-on-one
- Small groups
- Whole group

5. How do you organize your classroom to create time to assess your Kindergarten students?

[A form box will be provided for answers.]

Preparedness

Imagine it is one month into the school year with your new Kindergarten class. Please indicate how prepared you would be to evaluate each of the following skills or concepts based on assessments (including observation) that you would have done **only** within the month of **September**. This does not mean that the students will have achieved all these skills or concepts, but rather that you would have an informed assessment of the child’s current ability.

[Numbers corresponding to the descriptors will not appear in the online survey, dots will appear, but the descriptors will be given values for data analysis when imported to Excel.]

	Completely unprepared	Mostly unprepared	Mostly prepared	Completely prepared
At the end of September, consider how prepared would you be to comment on each child’s ability to...				
1. Read his or her own name	1	2	3	4
2. Print his or her own name	1	2	3	4
3. Identify letters in his or her own name	1	2	3	4
4. Identify all the letters in the alphabet (out of order)	1	2	3	4
5. Make corresponding sounds for all the letter in the alphabet	1	2	3	4
6. Name a word that begins with each letter in the alphabet	1	2	3	4
7. Attempt to write words	1	2	3	4
8. Use words and pictures to convey meaning	1	2	3	4
9. Read a simple picture book	1	2	3	4
10. Demonstrate concepts of print	1	2	3	4
11. Listen to a story	1	2	3	4
12. Follow directions	1	2	3	4
13. Speak aloud	1	2	3	4

Additional comments on preparedness for commenting on each Kindergarten child’s **literacy** abilities in September: *[A form box will be provided.]*

Preparedness (continued)

[Numbers corresponding to the descriptors will not appear in the online survey, dots will appear, but the descriptors will be given values for data analysis when imported to Excel.]

	Completely unprepared	Mostly unprepared	Mostly prepared	Completely prepared
At the end of September, consider how prepared would you be to comment on each child's ability to...				
14. Count to 10	1	2	3	4
15. Print the numerals 0-9	1	2	3	4
16. Identify numerals 0-9 (out of order)	1	2	3	4
17. Order numbers 0-10	1	2	3	4
18. Identify shapes (circle, square, triangle, rectangle, oval, etc.)	1	2	3	4
19. Measure with non-standard unit	1	2	3	4
20. Reproduce patterns	1	2	3	4
21. Create patterns	1	2	3	4
22. Extend patterns	1	2	3	4
23. Demonstrate an understanding of broad time concepts	1	2	3	4
24. Show additions situations (with manipulatives)	1	2	3	4
25. Show subtraction situations (with manipulatives)	1	2	3	4
26. Help to create graphs based on likes/dislikes	1	2	3	4

Additional comments on preparedness for commenting on each Kindergarten child's **mathematics** abilities in September: *[A form box will be provided.]*

Support

For the following questions, please select the descriptor that best describes your attitude toward each statement in regards to your belief or practice.

[Numbers corresponding to the descriptors will not appear in the online survey, dots will appear, but the descriptors will be given values for data analysis when imported to Excel.]

	Completely disagree	Mostly disagree	Mostly agree	Completely agree
1. I feel supported by my school administration in the area of literacy readiness.	1	2	3	4
2. I feel supported by my school board in the area of literacy readiness.	1	2	3	4
3. I feel supported by my provincial education department in the area of literacy readiness.	1	2	3	4
4. If you answered “ Completely agree ” or “ Mostly agree ” to any question (1-3), please describe how you feel supported in the area of literacy readiness: <i>[A form box will be provided.]</i>				
5. If you answered “ Completely disagree ” or “ Mostly disagree ” to any question (1-3), please describe how you would like to be supported in the area of literacy readiness: <i>[A form box will be provided.]</i>				
6. I feel supported by my school administration in the area of mathematics readiness.	1	2	3	4
7. I feel supported by my school board in the area of mathematics readiness.	1	2	3	4
8. I feel supported by my provincial education department in the area of mathematics readiness.	1	2	3	4
9. If you answered “ Completely agree ” or “ Mostly agree ” to any question (6-8), please describe how you feel supported in the area of mathematics readiness: <i>[A form box will be provided.]</i>				
10. If you answered “ Completely disagree ” or “ Mostly disagree ” to any question (6-8), please describe how you would like to be supported in the area of mathematics readiness: <i>[A form box will be provided.]</i>				

Figure 40: Thank You Page as Seen Online

The screenshot shows an Internet Explorer browser window displaying the URL <http://www.msvu.ca/education/survey/ThankYou.asp>. The browser's address bar and menu bar are visible at the top. The page content includes the Mount Saint Vincent University logo and navigation links such as 'Student WebMail', 'Apply Online', and 'Library'. A search bar is located in the top right corner. The main content area features a large blue 'Thank You' heading and a message of appreciation for completing a survey. Below the message is a text input field for comments and a 'Submit Comment' button. The footer contains contact information for the university, including the address '166 Bedford Highway, Halifax, N.S.' and the email 'admissions@msvu.ca'.

Thank you

Thank you for taking the time to complete this survey on Kindergarten teachers' perceptions of incoming students' readiness. If you would like to make any additional comments on this topic for the study, please use the space provided below (anonymity is assured).

[A form box will be provided for answers.]

If you are interested in receiving results from this study in Spring 2009, please remember to reply to your Recruitment Email.

If you have any questions or comments about this study, please direct them to:

Shannon Squires
Researcher

Shannon.Squires@msvu.ca

Geneviève Boulet
Supervisor

Genevieve.Boulet@msvu.ca

If you have questions about how this study is being conducted and wish to speak with someone who is not directly involved in the study, you may contact the Chair of the University Research Ethics Board (UREB) c/o MSVU Research and International Office, at 457-6350 or via e-mail at research@msvu.ca